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REPORT

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AGRICULTURAL EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

SEVENTEENTH ANNUAL REPORT

1904

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AGRICULTURAL EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

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ARKANSAS EXPERIMENT STATION,

FAYETTEVILLE, ARK., September 1, 1904.

To His Excellency, JEFFERSON DAVIS,

Governor of Arkansas:

SIR—

I have the honor to transmit to you herewith the Seventeenth Annual Report of the Arkansas Agricultural Experiment Station.

Most respectfully,

W. G. VINCENHELLER,

Director.

Agricultural Experiment Station.

BOARD OF TRUSTEES.

His Excellency, JEFFERSON DAVIS, *President*.

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STATION STAFF.

W. G. VINCENHELLER	DIRECTOR.
R. R. DINWIDDIE, M. D.	Pathologist and Bacteriologist.
C. L. NEWMAN, M. S.	Agriculturist.
ERNEST WALKER, B. S. A.	Horticulturist and Entomologist.
J. F. MOORE, B. S.	Chemist.

Correspondents should notify the Director of any change of Post Office Address, error in Address, or failure or delay in receiving Bulletins.

W. G. VINCENHELLER, Director.
Fayetteville, Ark.

REPORT OF DIRECTOR.

The published experiments of the Station for the year 1904 appear in full in succeeding pages of this report. The year's experimental work was published in six bulletins, which were mailed to all addresses on the Station's mailing list. A total of 54,000 copies was mailed out. The subjects of the bulletins are as follows:

Bulletin 77—Cowpea Experiments. By C. L. Newman.

Bulletin 78—Experiments with Edible Oils. By J. F. Moore.

Bulletin 79—Peach Growing in Arkansas. By Ernest Walker.

Bulletin 80. Cowpea Hay. By C. L. Newman.

Bulletin 81—Fertilizers. By A. M. Muckenfuss.

Bulletin 82—Live Stock Sanitation in Arkansas. By R. R. Dinwiddie.

The financial statement of receipts and expenditures for the year appears below.

W. G. Vincenheller,

Director.

FINANCIAL REPORT

Agricultural Experiment Station.

In Account with the United States Appropriation.

1904. DEBIT.

To receipts from the Treasurer of the United States as per Appropriation for the year ending June 30, 1904	$15,000.00
	$15,000.00

CREDIT.

By Salaries	$ 8,173.13
Labor	2,153.01
Publications	875.75
Postage and Stationery	315.17
Freight and Express	164.16
Heat, Light and Water	136.29
Chemical Supplies	383.70
Seeds, Plants and Sundry Supplies	979.70
Feeding Stuffs	341.08
Library	117.81
Tools, Implements and Machinery	.00
Furniture and Fixtures	12.00
Scientific Apparatus	27.16
Live Stock	9.00
Traveling Expenses	460.14
Contingent Expenses	101.90
Building and Repairs	750.00
	$15,000.00

The foregoing statement is copied from the Experiment Station books, which have been examined and approved by the Auditing Committee of the Board of Trustees.

W. G. Vincenheller,
Director.

COWPEAS.

By C. L. Newman.

Since the publication of Bulletin No. 70 (Cowpea Experiments), letters have been received from eighteen states and two territories making inquiries concerning this important crop. A majority of these letters of inquiry related to varieties and sources from which seed may be procured. It is probable that 40 per cent of the letters from this State reaching the office of the Agriculturist since Bulletin No. 70 was mailed, have sought information of one kind or another relating to cowpeas. A review of these letters of inquiry gives a good idea of the nature of the information sought by the farmers of the State. The object of the Bulletin is, as far as possible, to supply this information, and in addition to report such experiments as have matured or that are deemed advisable to publish at the present time.

In 1902 more than 350 plots were grown on the Station grounds, and 54 of these were planted in spots, selections and crosses, some of which are quite promising.

RAINFALL FROM 1898 TO 1902, INCLUSIVE.

The cowpea seems to be less affected by either drouth or excessive rainfall than any other crop grown at the Experiment Station. In fact, the effects of excess of rain has invariably caused a decrease in the yield of grain and a deficient rainfall a marked increase in grain. The following table gives the rainfall for five years, omitting November and December of each year, and the average yield per acre of shelled peas and of hay:

MONTH.	1898	1899	1900	1901	1902
January	4.62	3.34	1.35	1.05	1.01
February	0.73	1.13	2.75	1.16	1.81
March	15.07	1.21	1.04	3.88	5.10
April	3.93	2.77	3.39	4.32	3.70
May	10.42	7.56	4.26	1.26	4.33
June	5.69	3.59	3.94	1.89	6.52
July	7.10	7.40	2.22	1.50	0.37
August	4.80	1.97	4.14	3.95	5.19
September	4.53	0.78	4.98	0.50	4.29
October	5.34	6.57	4.64	2.64	4.84
Total	62.23	36.32	32.67	22.15	37.16

	1898	1899	1900	1901	1902
Hay per acre in pounds	3,268	3,054	2,781	3,873	3,042
Peas per acre in bushels	12.3	13.7	21.3	28.4	13.4

An inspection of the above table will show that the yield of peas was greatest in 1900 and 1901, the two years with the least rain, and that in 1898, 1899 and 1902, the years of greatest rainfall gave the lowest yields, and very near one-half that of 1900 and 1901. Several correspondents have reported the same observation. The table containing the yields of peas and hay embrace the average yields of ten varieties that have been grown for the five years named, and the results are construed as conclusive evidence of the value of the cowpea as a drouth resistant crop. The highest average yield of hay was also recorded on the year of least rainfall. The yield of hay is, however, less affected by rainfall than the yield of peas. It is probable that this falling off in the yield of peas is due to a large extent to mildew, a disease to which the cowpea is to a high degree susceptible in damp weather. In 1901, when the rainfall was most deficient, there was but slight damage done by this disease.

In 1902, when the rains of August, September and October were accompanied by an unusual amount of cloudy weather, mildew was prevalent to a great extent, and many of the pea blossoms fell off before they opened. With some varieties it was estimated that fully nine-tenths of the blossoms failed to set pods, while some pods that formed were destroyed by mildew before they reached maturity.

PREPARATION OF SOIL AND PLANTING.

It is usually the custom in many sections of the South to give very sorry preparation to soil intended for cowpeas. The writer's experience seems to lead to the conclusion that the cowpea will respond as profitably to good preparation as will corn, cotton or potatoes, and cultivation has been profitable in proportion to its thoroughness and frequency usually resulting in 50 per cent increase in the yield of peas and a profitable increase in hay. Cultivation before the plants blossom is of far greater benefit than later.

Until the last few years the great bulk of the pea crop was planted in corn and usually between the rows and after the last cultivation. Some were planted earlier in the corn rows and covered with the hoe when the corn was hoed the last time, one man being able to plant from one to three acres per day, the area planted depending upon the weediness of the corn field at the time of planting.

This plan of planting cowpeas in corn cannot be too highly recommended, the cowpea crop not infrequently being equal to from one-half to the full value of the corn crop (see Bullein No. 70, p. 104), while the cost of the crop of peas thus grown need not be greater than the cost of the seed and the cost of planting them, all of which should not exceed one dollar per acre. Cowpeas sown in corn should be grazed, after the corn has been harvested, first by hogs, and later by horses, cattle or sheep. This plan saves the cost of cutting, curing (often a risky undertaking), and housing the hay, and the subsequent labor of handling in feeding, while practically all the fertilizing value of the vines, except that utilized by the animal in its increase of weight, remains on the soil for the benefit of the next crop and the permanent improvement of the land. (See Bulletins Nos. 58, 62, 66 and 68.)

As the value of the cowpea becomes appreciated it is found that it is readily adjustable to any system of rotation, and in 1902 the area sown in Arkansas was commensurate with the available supply of seed, notwithstanding the fact that the price of seed was higher than ever before.

In the southern portions of the State cowpeas may be planted from the first of April to the middle or latter part of August. In the northern part of the State they can rarely be planted before the first of May or later than the middle of August. This gives in the southern portions of the State four and a half months open to planting and three and a half in the northern portion. Thus the cowpea may follow the crops that mature in the spring or early summer, may precede those that are sown in the fall, and may be sown with or in several crops that occupy the soil from April or May, until August, September or October. If planting is done after July 1, due consideration must be given the variety planted, since the period of ripening varies between 60 and 200 days in different varieties. Some varieties have repeatedly failed to produce seed at Fayetteville when planted early in May or later. For late planting the following varieties may be depended upon in the order named: New Ear, Warren's New Hybrid, Warren's Extra Early, Old Mans, Extra Early Black Eye and Whippoorwill.

Cowpeas are now to an extent greater than ever before planted as a main crop, or second crop, for either shelled peas, hay, pasturage, cover crop, or fertilizer, or for two or three of the above purposes. Planted at whatever time, thorough preparation is insisted upon. The soil should be well broken and harrowed until well fined. If rolled and an additional harrowing be given the results will be all the better. The most convenient and at the same time most profitable place in rotation that may be given the cowpea is as a second crop following wheat, oats, rye, barley, Irish potatoes, crimson clover, vetch, truck crops, or any crop that is harvested in May, June or July. If early varieties are then planted they may be harvested or pastured in time to seed the same land to any of the above crops (except Irish potatoes), while for the second crop of Irish potatoes an early variety of cowpeas sown in May or not later than the middle of June, affords the best preparation for planting the potatoes early in August. In such a case the peas should be converted into hay, and the ground immediately prepared for the second crop potatoes. In addition to the value of the grain and hay secured from cowpeas grown after grain harvested in the spring and before grain seeded in the fall, there is an increase in the value of the subsequent crop of grain greater than the cost of the crop of cowpeas. (See Bulletins Nos. 62 and 66.)

Of the various methods employed in planting cowpeas for grain, none have given so good results as planting with ordinary corn planters and in rows from 2½ to 3½ feet apart, 3 feet being preferred. For hay, the grain drill with every other tube plugged, has been the most economical of seed and time, and leaves the surface of the soil in best condition for harvesting with the mower. All but two or three of the tubes of the grain drill may be plugged, thus planting two or three rows at once, and the planting done more rapidly than with a single row corn planter. Thus planted, the cultivation may be done either with double shovel, heel sweep or cultivator. In the southern portion of the State, where corn rows are at times five feet apart, it is preferable to plant the peas with corn planter, half way between the rows of corn after the next to the last cultivation, since the space between the rows of corn and peas will admit of cultivation after the peas have begun to grow. It is not advisable to plant the climbing varieties in corn if the land is rich, since the dense growth of pea vines will overrun, interfere with gathering and possibly injure the corn. On such land the bunch varieties should be planted. Cowpeas may also be planted between rows of sorghum as suggested for corn. If the sorghum is planted early and early maturing varieties of cowpeas seeded when the sorghum is given the last cultivation, the cowpeas will make a profitable growth after the sorghum is harvested in September.

The depth to which cowpeas should be planted varies with the season of the year and the condition of the soil as regards moisture. A large majority of the varieties of cowpeas will rot in the ground if planted before the soil has become warm in the spring and the early plantings should be as shallow as possible if the soil has in it sufficient moisture to sprout them. As the season advances they should be planted deeper, but not deeper than three inches. If a hard, baking rain should fall after the seed are planted and before they have come up, the soil should be stirred, preferably with a weeder or harrow. After comparing many tests of drilled and broadcasted cowpeas the practice of broadcasting has been abandoned, except in special cases. Drilled cowpeas have always produced more grain than broadcasted, and more hay, except in abnormally wet seasons. One-fifth or one-fourth of a bushel of seed *drilled* has usually given a heavier yield of vines and from two to five times as many bushels of peas per acre as any amount of seed sown up to three bushels per acre *broadcast.* In 1900, one peck of Whippoorwill peas gave 3314 pounds of hay and 31.4 bushels of peas per acre, while 8 pecks of seed gave only 1747 pounds of hay and 16.4 bushels of peas. The two plots were treated alike in every respect, excepting the quantity of seed sown, and no difference could be detected in the fertility of the two plots. (See pp. 100 and 101, Bulletin No. 70.) In 1901, 12.5 pounds of seed per acre yielded 2675 pounds of hay per acre and 36.17 bushels of peas per acre, while 100 pounds of seed under identical circumstances gave only 2275 pounds of hay and 19.66 bushels of peas per acre. There was not only a waste of seed in both years' trials, but the large quantity gave a reduced yield equal in some cases to very near half that produced by the smaller quantity of seed. In these two tests the larger quantity of seed was eight times greater than the smaller.

CULTIVATION.

In the Southern States cowpeas usually produce profitable crops upon the poorest soil and with the most indifferent cultivation or none at all. This fact has led many growers to neglect their cultivation, and the prevailing custom of sowing broadcast usually prohibits it. In the cotton section a person cannot go further in expressing the extremest degree of a soil's infertility than by saying "it is too poor to grow cowpeas." That they will grow in any soil, and with so little care and attention emphasizes the value of this crop, and at the same time interferes with its being given the cultural attention it deserves. While good preparation is half the battle in the culture of any crop, a large portion of its benefits is lost if not supplemented by cultivation, if the nature of the crop admits of it. In a number of tests on the Station grounds, cultivation has never failed to give a profitable increase in the yield of hay, while the increase in the yield of peas has invariably exceeded 50 per cent, and in several cases been more than 100 per cent greater than secured from uncultivated areas. The best and the most economical cultivation, while the crop is in its early stages of growth, is secured by the use of the weeder. This valuable implement must be used when the weeds are quite young, or it will not destroy them. It is to prevent the growth of weeds rather than destroy them after they have gained headway. The destruction of weeds is but a secondary object of cultivation. The greatest benefits are in the improvement of the physical condition of the soil, encouraging aeration, nitrification and the conservation of moisture. The weeder accomplishes these if its use is begun early and repeated frequently. The heel-sweep, the double-shovel and the cultivator are among the best tools for cultivating drilled cowpeas. The weeder may be used to advantage on both broadcast and drilled peas from the time they are planted until the fourth or sixth week of their growth, when cultivation should cease with those broadcasted, but continued by the use of the heel-sweep, cultivator or double-shovel in the drills. When proper rotation and cultivation are practiced in the culture of cowpeas, there are but few weeds to contend with. The cowpea in common with other leguminous plants possesses the power of utilizing atmospheric nitrogen in its growth. The stirring of the soil by cultivation encourages the circulation of soil air and presents conditions more favorable for the development of nitrifying organisms without detracting from the more apparent benefits of cultivation.

FERTILIZING COWPEAS.

On account of the fertilizing value of the cowpea and the fact that it gives proportionately better returns from poor soil than probably any other crop, it is usually considered unprofitable to apply to it either commercial fertilizers or other manures. That the affects of nitrogen, phosphoric acid and potash alone and in combination might be noted, several plots of Whippoorwill peas were sown upon light sandy soil in May, 1900, and the yield of peas and hay determined. The soil was occupied by rye from September, 1899, to April, 1900, and the rye was plowed in three weeks before the peas were drilled in 3½-foot rows. Frequent shallow cultivation was given until the vines interfered with the passage of the cultivator between the rows. The following table gives the result:

No. Plot.	Description of Plot.	1901		1902	
		Bushels of Peas per Acre.	Yieldof Hay per Acre in Pounds.	Bushels of Peas per Acre	Pounds of Hay per Acre.
1	No Manure	27.5	2341	21.1	2462
2	50 pounds Muriate of Potash	31.4	2689	25.6	2977
3	200 pounds Acid Phosphate	32.7	3140	32.1	3269
4	75 pounds Nitrate of Soda	25.9	2594	22.6	2552
5	50 pounds Muriate of Potash 200 pounds Acid Phosphate	36.4	3784	34.7	3974
6	No Manure	24.3	2481	22.6	2394
7	200 pounds Acid Phosphate 75 pounds Nitrate of Soda	30.4	3705	35.1	4009
8	75 pounds Nitrate of Soda 50 pounds Muriate of Potash	31.6	3441	29.4	3842
9	No Manure	27.8	2224	19.4	2261
10	50 pounds Muriate of Potash 200 pounds Acid Phosphate 75 pounds Nitrate of Soda	35.9	3878	26.6	4288

These fertilizer tests very clearly indicate that applications of nitrogen do not benefit the cowpeas on the Station soil. The three unfertilized plots produced .63 of a bushel more of peas than the nitrate of soda plot (No. 4), and the nitrate of soda only added 245 pounds of hay to the yield as compared with no manure. Wherever phosphoric acid or potash were used, whether in combination or alone, there was quite a substantial increase in both peas and hay. Phosphoric acid (Plot 3) increased the yield of peas and hay 26.2 and 21.0 per cent over nitrate of soda (Plot 4); and muriate of potash (Plot 2) gave 21.2 per cent increase in peas, but only 3.1 per cent increase in hay over nitrate of soda (Plot 4). Phosphoric acid and muriate of potash combined gave 40.5 per cent increase in peas and 45.8 per cent increase in hay over nitrate of soda. Muriate of potash and phosphoric acid combined gave a few more peas and a few less vines than where nitrate of soda was added to these two fertilizers.

For two or three weeks after the peas had germinated the plots to which nitrate of soda had been applied appeared to have a deeper color, and to be in more vigorous growth, than any of the plots not receiving nitrate of soda. After the third week it was evident that the plots with mineral fertilizers were in more vigorous growth, and the difference in their favor was marked throughout the remainder of the season. The young pea plants utilized the nitrogen of the readily soluble nitrate of soda before the development of the nitro-gathering tubercles, and, their early growth was thus stimulated, but not to an extent sufficient to show in the final yield except in a very slight increase in vines, which was not sufficient to compensate for the cost of the nitrate of soda applied. If cowpeas are to be used for the purpose of restoring impoverished lands the application of phosphoric acid and potash would usually result in profitable returns from the cowpeas and always to the crop following the cowpeas. The application of phosphoric acid and potash to a crop of cowpeas grown for fertilizing a truck crop that is to follow the cowpeas will probably give better returns than when the application of the mineral fertilizers is made directly to the crop it is intended for.

THE FERTILIZING VALUE OF COWPEAS.

In the South cowpeas are grown for four purposes: Grain, hay, pasture and fertilizer. Usually the first three are primary or immediate objects and results of their culture, and the last secondary or incidental. Grown for whatever purpose, they reward the planter by increasing the productive capacity of his soil, and are fertilizers wherever and whenever grown in appropriate rotation. Throughout the civilized world legumes are grown for the purpose of increasing the fertility of soils. These legumes are usually slow to develop, and as a rule occupy the soil one or more years before the greatest good results. They must be sown in early spring or in the fall, and are not so well adjusted to the requirements of southern systems of rotation, and are particularly unsuited for rapid rotation with grain crops. The cowpea possesses all the good qualities of these other legumes to a maximum degree and develops them in a minimum of time. With the exception of the velvet bean, the cowpea is of more rapid growth than other cultivated legumes, and assimilates the greatest amount of plant food in the shortest time. This apparent superiority of the velvet bean does not hold in practice, since it does not mature seed in this State in sufficient quantity to avoid the purchase of a new supply for each crop, and the tangled vines usually prohibit their being harvested for hay or plowed into the soil in an acceptable manner.

Every cultivator of the soil should have for his chief aim its permanent improvement. It costs no more to grow a crop of wheat, corn or cotton on rich soil than on poor. The increased yield above the cost of production is profit. If one acre will produce twelve bushels of wheat at a cost of six bushels, there remains a profit of six bushels per acre. If another acre produces twenty-four bushels at the same cost there is a profit of eighteen bushels, an increased profit of 300 per cent from doubling the yield. There is no one thing that the farmer should keep more constantly in mind than the necessity of increasing the fertility, or producing capacity of his land. For the past four or five years the Experiment Station has carried on a number of experiments for the purpose of determining the fertilizing effects of cowpeas grown between successive crops of oat, wheat and other crops. In every instance when these tests have been conducted on soil of moderate fertility for the benefit of either oat or wheat, the profit derived from the crop of cowpeas has been greater than the profit from the above-mentioned grains, notwithstanding that the oats and wheat have yielded an average increase of a little more than 40 per cent induced by the cowpea. In one case a plot sown to cowpeas in the spring produced $18 worth of hay and was followed by a crop of oats valued at $18.50, making the returns from the acre $36.50. Another plot of oats that had not followed cowpeas yielded only $11.58 worth of oats. In the same length of time the plot planted to cowpeas and oats yielded $36.50, while the oats alone yielded only $11.58. This was an increase in value of more than 300 per cent, and the soil was more fertile at the end of the period than it was at the beginning. In another case cowpeas grown just before a crop of wheat and cut for hay, produced $19.33 worth of hay and the pea stubble increased the yield of the following crop of wheat 61 per cent. The wheat was valued at $13.20, making a total of $32.53 against $8.08 worth of wheat grown on an adjacent plot and not preceded by a crop of cowpeas. This represents a 400 per cent increase in the value of the products taken from the soil, due solely to the growing of one crop of cowpeas before the soil was seeded to wheat. In this case the value of the cowpea hay was $6.13 more than the value of the crop of wheat, notwithstanding an increase of 61 per cent in the yield of wheat from the fertilizing effects of the cowpea stubble. These tests were made on a light sandy soil, deficient in vegetable matter, and would ordinarily produce ten or twelve bushels of wheat. This character of soil prevails throughout the South. It responds promptly and profitably to fertilization, and particularly is the response noticeable where the fertilization is brought about by the application of bulky vegetable materials of approved composition, such as leguminous plants, stable manure and the like. Such materials not only give better returns than are secured from the use of commercial fertilizers, but the effects are more lasting. They increase the moisture-holding and moisture-retaining properties of the soil, improve its physical properties and present conditions more favorable to nitrification.

In 1889, a series of tests were inaugurated for the purpose of determining the residual effects of the manural constituents of cowpeas as compared with commercial fertilizer. These tests were made with wheat, and the phosphoric acid, potash and nitrogen of the fertilizers were combined in the proportions demanded by wheat. The four years' results appear in the following table:

No. of Plots.	TREATMENT OF PLOTS.	Years Wheat was Harvested BUSHELS PER ACRE.				Total Yield for Four Years.
		1899	1900	1901	1902	
1	Wheat following wheat five years..........	10.8	10.4	9.9	10.2	41.3
2	Cowpeas each year after first crop.........	11.1	14.3	14.8	16.9	57.1
3	Cowpeas—whole plant plowed in in 1898...	15.8	14.8	11.8	11.8	54.2
4	Cowpeas—stubble plowed in in 1898.......	15.8	12.2	10.1	10.9	49.0
5	100 pounds nitrate of soda in fall of 1898...	13.7	9.8	9.4	10.1	43.0
6	200 pounds nitrate of soda in fall of 1898...	14.0	10.2	9.5	10.3	44.0
7	400 pounds complete fertilizer in fall of 1898	14.9	11.6	10.4	10.8	47.7
8	600 pounds complete fertilizer in fall of 1898	15.4	12.0	10.4	10.8	48.6
9	800 pounds complete fertilizer in fall of 1898	15.9	14.1	10.9	11.2	52.1
10	Cowpeas—whole plant plowed in in fall of 1898	15.6	16.4	13.3	13.8	59.1
11	Cowpeas—stubble plowed in in fall of 1898	16.2	13.9	10.8	11.2	52.1
12	Wheat following wheat five years..........	10.4	10.8	8.1	9.8	39.1
13	Cowpeas each year after first crop.........	10.6	14.9	15.3	17.6	58.4

In 1898 the whole area devoted to the above tests was in wheat and in orchard grass the previous year. After the 1898 wheat crop was harvested the land was thoroughly broken and rebroken three months later, and just before the 1899 crop was sown in October, 1898. Plots 3, 4, 10 and 11 were sown to Whippoorwill cowpeas immediately after the wheat crop of 1898 was harvested. All plots were plowed alike when prepared for the cowpeas, and again plowed and prepared when the pea plots were sown to wheat. The whole cowpea plant was plowed in on plots 3 and 10, and only the stubble on plots 4 and 11. These four plots were not again sown to cowpeas or fertilized. They were plowed twice each year between the harvest of one crop and the sowing of the next, which was true also of all of the thirteen plots. After harvesting the wheat of 1899, plots 2 and 13 were sown to cowpeas and the vines mown for hay, only the stubble being plowed in. This sowing and harvesting of cowpeas between crops of wheat was continued throughout the test on plots 2 and 13. Plots 5-9, inclusive, received applications of fertilizers designated only before the sowing of the 1899 crop. No further care was given the soil of these plots between crops of wheat except the plowing just after the harvesting of one crop and just before the sowing of the next.

The crop of wheat harvested from plots 1, 2, 12, and 13 (which were not preceded by a crop of cowpeas) gave an average yield of 10.72 bushels of wheat per acre, while plots 2, 4, 10, and 11, that were preceded by cowpeas, produced 15.85 bushels of wheat per acre, an increase of a little more than 50 per cent induced by the cowpeas. The fertilizer applied to plot 9 (800 pounds) cost $11.20 delivered at Fayetteville, yet this heavy application caused an increased production of only .05 of a bushel more than the average increase of plots 2, 4, 10, and 11, sown to cowpeas. Plot No. 11, fertilized with only the stubble of cowpeas, produced .03 of a bushel more than plot 9, to which was added 800 pounds of commercial fertilizer valued at $11.20.

These remarks have taken into consideration only the first year's results which conform closely to those published in Bulletin No. 62 of this Station. Plot No. 1 shows a decrease each year from the first year's yields, and plot No. 12 each year after the second. These two plots must be used as standards for comparison, by which the measure of the good effects of the commercial fertilizers and of the cowpeas may be determined. The slight falling off in yield in 1901 is attributed to the decided deficiency in precipitation for that year, and has no bearing upon the fairness of the conclusions.

The average yield for the four years of plots (1 and 12) upon which no fertilizers were used or cowpeas grown, was 10.05 bushels per acre. The whole cowpea plant plowed in (plots 3 and 10) gave an average increased yield of 16.55 bushels per acre, and the stubble (plots 4 and 11) an increase of 10.45 bushels per acre for the four years. These increases resulted from growing cowpeas but once, and before the first crop of wheat was sown. Cowpeas planted between each crop of wheat (but not before the first) gave an increase of 17.65 bushels per acre for the four years against an increase of only 12 bushels from 800 pounds of fertilizer applied to the first crop of wheat. Two hundred pounds of nitrate of soda applied to the first of four successive crops gave a gross yield of only one bushel more than 100 pounds. The average yield of the two nitrate of soda plots gave only 3.4 bushels more in four years than the yield of plots 1 and 12, receiving no manures, while the first year's yields shows an increase of 6.5 bushels from the nitrate of soda plots over plots 1 and 12. Comparing the plots fertilized with nitrate of soda with plots 4 and 11, we have an average yield of 2.15 bushels more from the stubble plots than from the nitrate of soda plots for the first year, while the value of the cowpea hay removed from the stubble plots was worth approximately three times as much as the nitrate of soda cost. The gross average yield of the stubble plot produced in the four years 7 bushels of wheat more than the nitrate of soda plots. This shows four items of profit derived from the stubble plots as compared with the nitrate of soda plots:

First, the saving of the cost of nitrate; second, an increased yield of 7 bushels of wheat; third, the value of hay cut from the stubble, and fourth, the 16 per cent increase in fertility of the land. After cutting the cowpea hay between the crops of wheat (plots 2 and 13) there remained in the soil an increase in fertility sufficient to produce in four years 17.55 bushels more wheat than was grown on plots 1 and 12, where wheat followed wheat for four years without cowpeas between, thus giving an increase of 40.8 per cent in the yield of wheat and in addition cowpea hay equal in value to the wheat grown on the same plots.

When the character of the soil upon which these experiments were conducted is taken into consideration, it is more than probable that the residual effect of whatever manural substances applied would be more lasting in soils less open and more retentive. This soil is a deep, gravelly, sandy loam, rolling, and has a somewhat porous subsoil. On the other hand it is just such soils that are more permanently benefited by the applications of slowly decomposing organic matter than by less lasting fertilizing materials. The 800 pounds of fertilizer on plot 9 plowed in at the same time as the cowpea vines of plot 10 gave .3 of a bushel more wheat in 1899, but 2.6 bushels less in 1902, under identical treatment from October, 1898, to June, 1902, while the fertilizing effects of the one crop of cowpeas plowed in in the fall was greater than the fertilizing effects of 800 pounds of complete fertilizer applied at the same time, adding 7 bushels of wheat to the yield in four years and leaving the soil more fertile at the end of four years than the 800 pounds of fertilizer left it.

Just how long the continuous growing of wheat (or other grain) with cowpeas between each crop would give increased yields of wheat would depend upon the quantities of phosphoric acid and potash in the soil and becoming available for each crop. That the cowpea stubble will supply a sufficient amount of nitrogen is evidenced by half a hundred experiments conducted by the Station within the past six years. This nitrogen, or at least the greater portion of it, is taken from the air while the phosphoric acid and potash must necessarily come from the soil, and the quantities of these two fertilizing ingredients removed by the cowpea hay and the crops of wheat represent the quantities removed from the soil. If deep plowing, the subsoiling effects of cowpea roots, weathering and other operating agencies do not render available quantities of phosphoric acid and potash proportionate to the quantity removed by the harvested crops, the soil will become gradually exhausted, notwithstanding the cowpeas, and it will become necessary to resort to direct applications of phosphoric acid or potash or both. Just how many years would elapse before this would become necessary will of course depend upon the composition of the soil and its past and present treatment, and can be determined only upon the merit or demerit of each case.

THE TIME TO PLOW UNDER COWPEA VINES AND STUBBLE.

The plowing under cowpea vines or cowpea stubble, like any other farm operation or practice, may be rightly or wrongly done. In utilizing a crop of cowpeas for their fertilizing effects, there are so many things that should be taken into careful consideration that each case must be adjudged by itself. In beginning the discussion of this subject the writer wishes it to be understood that he does not advocate plowing under cowpea vines except in special cases and in following thoroughly considered and well-matured plans. On a well-regulated farm and under ordinary circumstances there is about as much common sense in plowing under cowpeas ready for the mower as there is in plowing in timothy, corn, wheat or cotton, instead of harvesting them for market or for feed, as the case may be. The greatest error in Southern farming is to be found in the small number and inferior quality of the animals kept. There is not one in fifty cotton-belt farms that has its complement of live stock. On the other hand, under the existing and peculiar conditions of many farms it is more expedient to use a crop of cowpea hay for fertilizer than for other purposes. A majority of the cotton states do not produce as much hay as they consume.

A ton of cowpea hay is worth as much as a stock food as a ton of wheat bran, and worth more, if a fair quantity of ripe peas are saved with the hay.

The most profitable use to be made of the cowpea plant is to feed it to live stock. Cowpeas are grown, however, quite extensively for plowing in, and the time of plowing them in is more frequently controlled by the convenience of the operator than by appropriateness of time, condition of the cowpeas, character of soil or nature of the crop that is to follow. Having grown a crop of cowpeas for its fertilizing effects upon the soil the treatment should be such as to secure the best results with the least harm to the crop that is to follow, and with the least loss of the fertilizing ingredients of the cowpea plant. If the soil is of a light sandy nature, and subject to washing by winter rains, fall plowing should be avoided unless there is an excessively large quantity of pea vines to be plowed in. In the South the soil is not frozen enough to prevent the decomposition of the vines in the winter, and there may be a decided loss of the fertilizing ingredients, and the heavy winter rains will do more damage to freshly plowed areas on rolling ground than the fall plowing will do good. A decided majority of southern soils are very subject to washing, and usually suffer greater loss of plant food by their not being protected from washing than by the removal of plant food in the crops taken from the soil. Such soils are not benefited by fall plowing so much as they are harmed, and need the protection of terraces and whatever vegetation it is possible to have upon them through the winter. Soils that are of a compact nature and not subject to washing are benefited by fall plowing, and on such soils the cowpeas may be plowed under in the fall. In either case, however, a winter cover crop will aid in binding the soil against washing and take up valuable plant food that otherwise would be lost. Upon light soils it is often a serious error not to follow fall plowing with rye, wheat, oats, or some other winter crop. These catch crops far more than pay their cost in improvement and protection to the soil, and may be harvested or plowed under in the spring to be followed by whatever crop it is the intention of the farmer to grow.

The quantity of vines that may have been produced has a direct bearing upon the time they should be plowed in. In 1902, one plot each of New Era and Extra Early Black Eye produced less than 800 pounds of hay per acre, and one plot each of Clay, Iron and Wonderful with identical treatment and on like soil, produced more than 8000 pounds of hay per acre. While such extremes in yields of hay is due entirely to variety habits, they are wider than have before occurred in the experience of the writer. Nevertheless, they serve to illustrate the necessity for different treatment when heavy or light yields of pea vines are to be utilized directly for fertilizing purposes. Should so light a growth as 800 pounds, or even twice this quantity of vines be plowed under in the fall a very large proportion of the most valuable fertilizing ingredients would disappear, in our mild climate, before planting time the following spring. The loss could, however, to a great extent be prevented by having the soil seeded to some winter growing crop, such as rye, vetch, wheat, etc., and so small a quantity of green vegetable matter plowed in would not perceptibly injure these winter crops. Should 8000 pounds of cowpea vines, or even half so much, be plowed under in the fall and followed by a winter crop, the damage of this large amount of fermenting and decomposing vegetation would seriously damage, if not destroy, the winter crop, if a liberal application of lime was not made (see Arkansas Experiment Station Bulletin No. 62). Furthermore, the varieties of cowpeas that produce the heaviest yield of vines usually continue green and growing until frost, if not harvested before frost occurs, and in this succulent condition are more calculated to do harm than more mature vines. Should soil occupied by a heavy growth of cowpeas in the fall be intended for some spring sown crop, it may or may not be advantageous that the vines be plowed under in the fall. In such a case the susceptibility of the soil to washing, its physical properties and local conditions and surroundings, should be considered, and without losing sight of the advantages of grazing the pea vines. When the time approaches for plowing under cowpea vines in the fall, the degree of maturity of the crop has an important bearing upon determining whether they should then be plowed or left over until the early spring. If the cowpea vines are mature, best results will usually come from fall plowing, particularly if the land is comparatively level, and mature vines plowed under may safely be followed by fall crops of grain, grasses or legumes. If green, they cannot safely be followed by such crops and best results will usually follow when they are permitted to remain until early spring, if not to be grazed. When cowpeas are plowed in and to be followed by another crop, the length of time that should elapse before the sowing of the next crop should be determined by the quantity and maturity of the vines when plowed in, and the weather conditions prevailing between the plowing in of the cowpea vines and the planting of the crop that is to follow. If plowed under in the fall it is not infrequently the case that dry weather follows the operation and the vines remain for some weeks in an undecomposed condition, or only partly decomposed. When rain does fall the vines are in much the same condition as when plowed under green with the soil in good condition as regards moisture.

It is often a difficult task to plow under a heavy crop of cowpeas and have the soil in good condition and the vines well covered. This difficulty is particularly noticeable when Iron, Clay, Red Ripper and such vining varieties are to be plowed under, the tangled mass of vines making it in many cases impossible to do a good job with the tools ordinarily found upon the farm. In plowing under such heavy crops the work may be done quite satisfactory if the field is first gone over with an ordinary stalk cutter, and in such manner that the furrows of the turning plow will be parallel with the direction of the stalk cutter. The blades of the stalk cutter cut the pea vines into strips at right angles to the furrow and a rolling coulter attached to the beam of the turning plow cuts the vines again, but at right angles to stalk cutter. The stalk cutter presses the vines near the ground, cutting them one way while the coulter cuts them again, enabling the plow not only to run more steadily, but to completely cover the pea vines, insuring their more rapid and uniform decomposition.

COWPEAS PLANTED IN CORN AT LAST PLOWING.

The very common practice of sowing cowpeas in corn when the latter is given its last cultivation suggested the experiment reported in Bulletin No. 70, page 104. This test shows that "the value of two successive crops of corn without cowpeas sown in them was $21 (per acre), while the value of two successive crops of corn plus the value of a crop of cowpeas sown in the first crop was $33.54 (per acre)." In the above test corn and peas were valued at 50 cents per bushel and cowpea hay at $10 per ton, which was the approximate local market value of these products in 1899 and 1900. In 1901 and 1902, these tests were repeated with additional plots from which the peas were gathered, but the vines allowed to remain in the field and grazed by cattle when the corn had been gathered. The local market value of cowpeas and corn in 1901 and 1902 was $1 and 70 cents per bushel, and cowpea hay $10 per ton. The severe drouth of 1901 lowered the average yield of corn to about one-third of a full crop. The yield of cowpeas, however, was the highest recorded at Fayetteville, and the cowpea hay yield was above the average for the past five years. Notwithstanding the unusual deficiency of moisture the presence of the growing cowpeas had no appreciable effect to lower the yield of corn. The following table gives the corn and pea yields and the value of the crops produced in two years:

No. plot	Description of Plot	Yield Per Acre				Value of the two years Crops
		1901			1902	
		Corn Bushels	Peas Bushels	Cowpea Hay, pounds	Corn Bushels	
1	No peas........................	8.4	.....	....	24.4	$22.96
2	Peas in drills...................	8.8	18.5	1889	31.9	55.83
3	Peas broadcast.................	8.0	9.9	1546	33.6	46.15
4	Peas in drills....................	8.4	19.3	Grazed	37.4	50.76
5	Peas broadcast.................	7.8	8.4	Grazed	39.2	40.70
6	No peas........................	9.1	.....	....	26.1	24.64

Value of cowpeas, $1 per bushel.

Value of cowpea hay, $10 per ton.

Value of corn, 70 cents per bushel.

Average value of product from plots without cowpeas, $23.80.

Average value of product from plots with cowpeas, both peas and hay harvested, $50.99.

Average value of yields from plots with cowpeas, peas gathered and hay grazed, $45.73 plus $8.58.

It must be remembered that no account is taken of the value of the vines on the plots grazed. The yield of cowpea vines was apparently as heavy on plots 4 and 5 as on plots 2 and 3, and it is fair to assume that the hay of plots 2 and 4 and 3 and 5 possessed equal value. In one case, however, the cost of cutting and housing was saved by having the vines gathered by the cattle, and it is fair to estimate the total value of the crops grown on plots 4 and 5 at from 10 to 20 per cent more than appears in the table. The plots sown to cowpeas in 1901 and grazed produced in 1902, 5.45 more bushels of corn than the plots from which the hay was harvested. Since the cattle were excluded from the field in wet weather (thus reducing the injury from trampling to a minimum), it is probable that the 5.45 bushels of increased yield from the grazed plots resulted from the droppings of the cattle, since they spent the greater part of their time on the plots from which the pea vines were not harvested. When records have been made of the yields of shelled peas planted in corn there has been from 50 per cent to 200 per cent increase in favor of planting in drills as compared with sowing broadcast, with comparisons of the same varieties of cowpeas. Some varieties sown broadcast in corn have yielded no peas. The yield of hay has rarely been as great from broadcast sowings as from drill culture, notwithstanding the deduction of the weight of peas and hulls from the drilled plots.

Referring to the results tabulated above, it will be seen that the total value of the two years' crops on plots 2 and 4 with drilled cowpeas is $50.99 per acre, and of plots 1 and 6, upon which no cowpeas were sown is $23.80 per acre. This is an increase of 113.8 per cent in value of crops grown the two years. The plots upon which the cowpeas were broadcasted gave an increase in value of 92.1 per cent per acre. These two estimates do not take into consideration the value of the vines grazed by the stock. A comparison of the value of the two years' crops produced on plots 1 and 2 shows an increase in value of 143.2 per cent per acre from drilling cowpeas over corn with no cowpeas. The corn used in these tests was the ordinary white dent usually grown in this locality. The variety of cowpeas sown was Warren's Extra Early, a variety particularly suited to late planting. This variety is the best general purpose pea tested by the station for a period of years. The New Era planted in corn at its last cultivation has uniformly given slightly better yields of peas, but less hay than the Warren's Extra Early.

The practice of growing cowpeas with corn is deserving of high commendation. The peas curtail the yield of corn to a very slight extent or not at all. The value of the shelled pea is not infrequently equal to the value of the corn gathered from the same area, and added to this is the value of the pea vines for cattle feed and the fertilizing value of the cowpea roots and stubble, shading and protecting from washing. In 1901, two plots of corn averaged but 8.6 bushels per acre, while cowpeas drilled betwen the corn rows yielded 18.9 bushels of shelled peas per acre, the drouth severely cutting off the yield of corn and apparently inducing greater fruitfulness of the peas.

It has been stated that no account was taken of the value of the pea vines grazed from plots 4 and 5. This was not done because no determination was made of the effects upon the animals that were employed in grazing the plots. The object of the test being to compare the effects upon the next crop of corn, of the grazed pea stubble with the mown pea stubble. This makes the total value of the crops grown upon plots 4 and 5 appear less than it really was, and it is perfectly fair to add to these figures the value of the hay gathered from plots 2 and 3, and to assume that the yields of hay on plots 2 and 3 were the same as on plots 4 and 5. This raises the total value of plots 4 and 5 to $60.20 per acre, $48.43 per acre, respectively, the drilled peas giving a value of $11.77 per acre more than the broadcast peas. Plot 1 without cowpeas yielded $22.96 worth of corn in two years, and plot 4 with drilled cowpeas (the peas gathered and the vines grazed), yielded with the corn $60.20 in value, an increased value of 162.1 per cent. Compared with plot 1 the broadcast peas of plot 5 gave an increased value of 110.9 per cent per acre of corn, peas and hay, by comparison with plot 1 planted to corn with no cowpeas.

Since the plots upon which cowpeas were grown in 1901 produced from 3.19 to 39.2 bushels of corn, and with no cowpeas produced only 24.4 and 26.1 bushels per acre in 1902, it is reasonable to suppose that the former plots are in condition for better crop production in 1903 than the latter. Thus the planting of cowpeas may be credited with four items of profit: (1) With an increase of 22.8 per cent in the yield of corn; (2) the value of the shelled peas; (3) the value of the pea vines; (4) the increased capacity of the soil for future crop production, any one of which exceeds the gross cost of planting, growing and harvesting the cowpeas.

COWPEAS AS A CATCH CROP AFTER WHEAT.

Experiments reported in Arkansas Experiment Station Bulletin No. 62, pp. 25 and 27, illustrate the beneficial effects upon wheat, but do not take into consideration the value of the cowpeas or cowpea hay. These omissions from the plan of the work leading to the results published in Bulletin No. 62, suggested the carrying out of similar tests in which the value of the cowpeas and the cowpea hay should be taken into account, as well as the increase in the yield of wheat.

The soil upon which this test was conducted produced a crop of rye and vetch in 1900. The rye and vetch were mown for hay and cowpeas sown broadcast. The cowpeas were cut for hay one week before the wheat was sown. As soon as the wheat was harvested the following June (1901) four varieties of cowpeas were drilled upon seven plots. One plot was left bare, but cultivated three times in July and August when the cowpeas were cultivated. When the crop of peas was harvested the eight plots were again sown to wheat. The yields and value of the two crops of wheat (1901 and 1902), the yields and value of the intervening crop of cowpeas and the total value of the crops occupying the soil from October, 1900 (when the first crop of wheat was sown), to June, 1902, when the second crop of wheat was harvested, are recorded as follows:

No. of Plot.	1901							1902		Total Value Crops of both 1901-1902
	Yield Wheat per acre	Value Wheat per acre	Yield Shelled Peas per acre	Yield Cow Pea Hay per acre	Value Shelled Cow Peas Per acre	Value Cow Pea Hay per acre	Total Value Crops in 1901	Yield Wheat per acre	Value Wheat per acre	
	Bu.		Bu.	Lbs.				Bu.		
1	14.7	$11 76	......	1,764	$.....	$ 8 82	$20 58	15.8	$12 64	$32 22
2	13.4	10 72	6.5	1,341	6 50	6 70	23 92	14.1	11 28	35 20
3	13.7	12 08	10.1	1,630	10 10	8 15	31 05	16.2	12 96	44 01
4	14.4	11 51	8.6	1,904	8 60	9 52	29 64	15.9	12 72	39 26
5	16.3	13 04	......	2,324	......	11 62	24 66	16.3	13 04	37 70
6	14.4	11 52	11.2	2,004	11 20	10 02	32 74	16.5	13 20	45 94
7	15.2	12 16	......	2,640	......	13 20	25 36	17.4	13 92	39 28
8	14.8	11 84	No	Cow-	peas	......	11 84	13.6	10 88	22 72

In the above test the cowpeas were drilled at the rate of 15 pounds to the acre. Plots 1 and 2 were seeded to Whippoorwill, plot 3 to New Era, and plots 4 and 5 to Extra Early Black Eye, plots 6 and 7 to Warren's Extra Early. Plot 8 was plowed with the others when they were being prepared for the cowpeas, and cultivated at the same time and in the same manner as plots 1-7, inclusive. The value of the cowpeas and cowpea hay grown after the wheat crop of 1901 was harvested was greater in some cases than the value of the wheat crop that preceded the cowpeas.

The average value of the crops of wheat and cowpeas grown on plots 1-7, inclusive, in 1901, was $26.85 per acre. These plots produced a crop of both wheat and cowpeas. The value of the crop of wheat gathered from plot 8, which was not seeded to cowpeas, was only $11.84. Thus the increased value of crops for the one year was 126 per cent on plots with cowpeas following wheat as compared with following the wheat with no summer crop. The cowpeas grown after wheat in 1901 added 1¼ bushels of wheat to the 1902 crop of wheat. The plots seeded to cowpeas after the wheat was harvested in 1901 produced in 1902 an average of 2.43 bushels more of wheat than the plot not seeded to cowpeas, an increase of 17.8 per cent.

COWPEAS FACILITATE PREPARATION OF SEED BEDS.

Aside from the manural effects of cowpeas upon crops that follow them, they afford conditions peculiarly favorable to the proper preparation of the soil for the reception of fall sown seed of whatever description or class. It is too frequently the case that grasses, clover, alfalfa, and the like fail to succeed for no other reason than that the soil was not properly prepared for the seed, and that a promising growth of these hay and pasture crops comes to naught on account of the survival of the more fit weeds. In preparing soil for hay or pasture plants one of the first essentials to success is the suppression of all weeds, and another is the thorough preparation of the soil for the reception of the seeds of these crops. Cowpeas have no superior in the suppression of weeds and greatly facilitate and cheapen the preparation of the soil immediately preceding the sowing of pasture and hay crops. The soil intended for such crops should be selected the fall before the seed are to be sown and then seeded to some grain. The grain will be ready for harvest in June, and up to this time will have prevented the ripening of practically all weed seed that will interfere with the future hay or pasture crops. Immediately after the grain is harvested cowpeas should be sown thick enough to quickly cover the soil and prevent further weed growth. The cowpeas may be sown broadcast or in drills—if in drills cultivation should be of such thoroughness and frequency as to prevent the growth of weeds until the cowpeas have complete possession of the soil. The cowpeas must be cut and removed in sufficient time for thorough preparation before the seed of the next crop are to be sown. The deeply penetrating roots of the cowpea have a sub-soiling effect upon the land, and the dense shade promotes intrification and improves to a marked degree the texture of the soil. Immediately after the removal of the cowpeas the soil should be prepared by frequent manipulations with such tools as discs, harrow, etc. If the treating and preparation for the preceding grain crop and for the cowpeas have been well done, going over the field three or four times with a good disc harrow will give an ideal preparation for grasses and clovers. Such treatment on well-tilled soil has given better results with winter wheat than were secured from deep breaking with a turning plow when no rain had fallen between the breaking of the land and the sowing of the wheat. Experience in a number of instances has proven the value of cowpeas for furnishing good conditions for fall sown crops and particularly for grasses and clovers, both alone and in mixtures.

VARIETIES OF COWPEAS.

In the early spring of 1902 the Station collected from various sources 123 samples of cowpeas, embracing about thirty varieties under about forty-five names. These were planted on 123 plots of equal size, each plot receiving the same number of seed and the stand finally reduced to the same number of plants for each plot. The seed were planted in drills 3½ feet apart, with a space of 7 feet between each plot. All plots were cultivated until the vines covered the ground. It was necessary that the field be gone over twice to turn back the vines of many plots to prevent their encroachment upon the territory of their neighbors seven feet away, while others barely met across the 3½-foot rows. The extremes in production of both hay and shelled peas is remarkable, varying from 8700 pounds of hay per acre to 700 pounds, and from 40 bushels of shelled peas to no peas at all.

The following table gives the names of varieties, sources of seed, number of peas required to weigh one ounce of both the seed planted and the seed gathered, weight of hay per acre, bushels of shelled peas per acre and per cent of peas in hulls:

No. Plot.	Variety	Weight per bu.	Source of Seed	No. Peas in one ounce		Yield hay in lbs. per bu.	Yield peas in bu. per acre	Per cent peas in hulls
				Planted	Gathered			
1	Whippoorwill	54	Arkansas	140	136	1300	13.3	67.3
2	Whippoorwill	55	Georgia	168	132	2500	8.5	66.1
3	Whippoorwill	55	Virginia	168	132	1700	14.1	65.4
4	Whippoorwill	54	Tennessee	156	124	2100	13.1	66.3
5	Whippoorwill	54	Louisiana	146	128	2200	13.3	68.0
6	Whippoorwill	54	....	160	128	1800	15.4	70.4
7	Whippoorwill	56	Florida	156	132	1900	17.7	65.8
8	Whippoorwill	55	Kentucky	164	132	1900	19.8	76.0
9	Whippoorwill	60	Tennessee	216	160	2100	20.8	68.0
10	Whippoorwill	56	Tennessee	140	128	1700	15.4	58.7
11	Whippoorwill	55	Georgia	152	132	1700	17.3	66.8
12	Whippoorwill	57	South Carolina	164	124	2300	11.6	52.3
13	Red Whipp'rwill	62	Georgia	184	156	5500	1.2	60.0
14	Whippoorwill	58	Georgia	148	132	1900	21.6	64.1
15	Whippoorwill	56	Georgia	164	132	1700	22.2	62.2
16	Clay	54	Arkansas	140	120	8700	2.1	58.3
17	Clay	55	Virginia	200	148	3800	3.7	60.0

No. Plot	Variety	Weight per bu.	Source of Seed	No. of Peas in one ounce		Yield hay in lbs. per bu.	Yield Peas in bu. per acre	Per cent Peas in hulls
				Planted	Gathered			
18	Clay	56	Georgia	168	116	4200	5.4	65.7
19	Clay	......	Tennessee	160	......	8200	.....	.....
20	Clay	54	Louisiana	196	128	4800	2.7	53.5
21	Clay	54	Alabama	148	144	7300	2.8	61.1
22	Clay	......	Louisian	192	140	8300	2.1	66.6
23	Clay	......	....	160	......	5900	.....	.....
24	Clay	56	Florida	144	120	4600	5.2	67.1
25	Clay	55	South Carolina	144	144	5000	6.7	61.4
26	Clay	......	Georgia	168	......	7400	.....	.....
27	Taylor	57	Arkansas	96	88	2800	8.9	64.7
28	Taylor	60	Virginia	100	96	2300	10.6	68.3
29	Taylor	60	Tennessee	112	92	Lost	8.1	66.0
30	Taylor	60	Tennessee	136	96	1700	8.1	64.2
31	Taylor	58	Maryland	132	88	2900	7.0	66.3
32	Taylor	59	Louisiana	112	82	2400	6.9	65.2
33	Taylor	60	Kentucky	88	86	1800	6.0	65.8
34	Taylor	60	Alabama	100	88	1700	3.7	66.6
35	Taylor	59	Tennessee	104	90	1700	6.9	64.8
36	Taylor	59	South Carolina	96	88	1900	6.0	60.2
37	Wonderful	......	Virginia	180	......	7000	.....	.....
38	Wonderful	......	Georgia	188	......	4600	.....	.....
39	Wonderful	......	Louisiana	136	......	4700	.....	.....
40	Wonderful	......	North Carolina	204	......	3300	.....	.....
41	Wonderful	......	Tennessee	168	......	4000	.....	.....
42	Wonderful	......	Louisiana	164	......	3000	.....	.....
43	Wonderful	......	Florida	146	......	7000	.....	.....
44	Wonderful	......	Kentucky	176	......	5700	.....	.....
45	Wonderful	......	Georgia	168	......	4400	.....	.....
46	Wonderful	......	South Carolina	180	......	5400	.....	.....
47	Wonderful	......	Georgia	176	......	4700	.....	.....
48	Wonderful	......	Georgia	153	......	4000	.....	.....
49	Wonderful	......	Georgia	168	......	8300	.....	.....
50	Red Ripper	57	Arkansas	144	124	4300	3.5	66.0
51	Red Ripper	......	Virginia	164	128	4500	1.7	60.0
52	Red Ripper	......	Georgia	184	......	3300	.....	.....
53	Red Ripper	......	North Carolina	184	......	3500	.....	.....
54	Red Ripper	......	Tennessee	146	......	4600	.....	.....
55	Red Ripper	55	Louisiana	186	124	3500	5.0	70.7
56	Red Ripper	56	Alabama	128	124	2300	7.1	63.8
57	Red Ripper	......	Louisiana	156	......	3800	.....	.....
58	Red Ripper	......	Florida	192	......	2600	.....	.....
59	Red Ripper	......	Georgia	150	......	4900	.....	....
60	Red Ripper	......	Georgia	188	......	3200	.....	....
61	Black	60	Louisiana	148	112	2700	19.6	65.2
62	Black	61	Arkansas	100	96	2400	13.0	63.2
63	Black	61	Virginia	144	136	2800	10.4	62.5
64	Black	......	Georgia	168	......	3900	.....	.....
65	Black Bunch	60	Louisiana	124	88	2300	15.0	66.0
66	Black	58	Tennessee	160	136	3900	6.0	65.1
67	Black	58	Louisiana	140	96	5100	3.3	61.5
68	Black	56	South Carolina	96	92	5100	9.1	66.6
69	Black	......	Georgia	136	......	5700	.....	.....
70	Crowder	55	Georgia	136	104	4900	5.0	68.5
71	Crowder	55	Arkansas	104	88	3900	4.1	68.9
72	Clay Crowder	53	Louisiana	112	80	5700	7.3	70.0

No. Plot	Variety	Weight per bu.	Source of Seed	No. of Peas in one ounce		Yield hay in lbs. per bu.	Yield Peas in bu. per acre	Per cent Peas in hulls
				Planted	Gathered			
73	Br'n Eye Crow'r	......	Alabama	108	92	2700	2.9	70.0
74	Sugar Crowder.	......	Alabama	120	......	7300	.....	.....
75	Speckle Crow'r.	58	Georgia	124	84	5800	12.5	75.0
76	Brown Crowder.	54	Georgia	124	96	6800	5.6	67.5
77	Clay Crowder	51	Arkansas	108	88	3700	11.4	71.4
78	Lge White Crow	......	Georgia	108	84	6200	2.5	75.0
79	Lady	54	Arkansas	236	176	4700	5.2	63.2
80	Lady	60	North Carolina	264	184	4800	6.2	65.2
81	Lady	......	Louisiana	280	......	3200	.....	.....
82	Jones Prolific	52	Alabama	196	148	2100	8.3	65.5
83	Conch	......	Louisiana	230	236	7600	11.2	55.4
84	Lady	59	Georgia	284	188	1700	10.8	65.0
85	Lady	59	Georgia	256	208	3600	5.2	69.4
86	New Era	60	Arkansas	208	176	1900	19.6	61.8
87	New Era	59	Virginia	220	180	1200	21.0	66.4
88	New Era	58	Maryland	248	196	700	22.3	68.3
89	NNew Era	60	Georgia	228	188	1300	19.6	67.1
90	Ex. E. Blk. Eye.	54	Arkansas	92	84	1200	15.8	70.3
91	Ex. E. Blk. Eye.	57	Virginia	124	100	1400	16.7	75.0
92	White Giana	58	Alabama	112	100	1100	16.1	64.4
93	Ex. E. Blk. Eye.	54	Kentucky	92	100	1800	20.0	75.0
94	Cal. Black Eye	60	Arkansas	108	104	1500	12.5	65.2
95	Black Eye	62	North Carolina	200	160	4000	11.2	71.0
96	Black Eye	59	Indiana	124	136	800	18.2	70.7
97	Black Eye	59	South Carolina	120	96	1600	15.2	67.5
98	Black Eye	59	Oklahoma	136	136	700	17.1	74.5
99	Black Eye	53	Georgia	112	104	1700	16.6	65.5
100	Large Black Eye	61	Arkansas	128	108	1000	16.4	69.9
101	Large Black Eye	59	Virginia	132	88	1200	11.6	71.2
102	Large Black Eye	59	Louisiana	204	104	3500	17.9	66.1
103	White Black Eye	62	Georgia	107	156	2900	21.0	64.3
104	Warren's Ex. E.	55	Arkansas	120	108	1700	23.5	64.2
105	Mt. Olive	57	Maryland	168	132	1100	22.9	56.9
106	Warren's Ex. E.	58	Pennsylvania	192	140	1600	26.2	67.7
107	Southdown	61	Virginia	224	160	4800	10.2	67.1
108	Calico	60	Louisiana	212	148	3100	6.2	68.7
109	Calico	60	Kentucky	136	148	3700	20.8	69.4
110	Coffee	57	Louisiana	132	134	Lost	20.4	69.0
111	Wild Goose	56	Arkansas	104	92	3100	16.6	68.9
112	Indian	59	Louisiana	128	84	7800	10.6	64.5
113	White Br'n Eye.	60	Louisiana	140	110	2100	20.8	71.0
114	Brown Eye	60	Arkansas	136	136	2200	18.3	70.9
115	Md Wht Brn Eye	61	Georgia	196	142	4300	5.0	72.7
116	Old Mans	54	Arkansas	180	160	1700	14.8	63.3
117	Warren's N. Hyb	55	Arkansas	200	158	1200	18.5	67.4
118	Red Yellow Hull	56	Louisiana	152	112	8000	29.1	77.5
119	Iron	59	Louisiana	188	176	6200	21.2	65.3
120	Iron	59	South Carolina	200	180	8300	23.1	55.2
121	Watson's Hybrid	60	Louisiana	200	146	5800	40.4	71.3
122	E. E. Brown Eye	58	Louisiana	140	112	3700	26.8	69.3
123	Speckled Java	59	Georgia	112	82	6900	22.7	68.5

The weights of hay given above do not include the peas.

An examination of the above table will show several results worthy of note. The heaviest yield of hay, 8700 pounds, was secured from Clay peas (plot 16), and the lightest, 700 pounds, from New Era and Black Eye (plots 88 and 98). No peas ripened on plot 16, while plots 88 and 98 produced 1330 and 1026 pounds of shelled peas, the peas weighing considerably more than the vines that produced them. Plots 37-49, inclusive, produced no peas at all and very few blossoms appeared on these plots, which were of the variety of Wonderful or Unknown. Red Ripper and Clay gave very few peas and on some plots none at all. The peas grown in 1902 were larger and heavier than the seed planted by an average of 20.24 per cent. Only six plots gave more peas to the ounce in 1902 than the seed planted. The seed grown north of the latitude of Fayetteville gave an average of 3388.1 pounds of hay per acre, and those south 3420.7 pounds per acre. The seed grown north of Fayetteville produced 1.3 bushels of shelled peas per acre more than seed grown south of Fayetteville. The following varieties gave the highest yields of shelled peas: Calico, Coffee, Extra Early Black Eye, Iron, New Era, Red Yellow Hull, Speckled Java, Warren's Extra Early, Warren's New Hybrid, Watson's Hybrid, Whippoorwill, and White Brown Eye.

New Era, Old Man's, Warren's Extra Early, Extra Early Black Eye, and Warren's New Hybrid yield a greater proportion of peas to vines than other varieties tested and are more productive of peas than other varieties when planted in corn or after grain, and are recommended for their early maturity.

THE RELATIVE DIGESTIBILITY OF SOME EDIBLE FATS AND OILS.

J. F. Moore.

During the last few years there has been a large increase in the number of brands of edible oils and of butter and lard substitutes found in our markets. An examination of a number of salad oils indicates that about 75 per cent of those offered for sale in this region are made wholly or in part of cotton seed oil. This oil is also an important factor in the manufacture of such substances as oleomargarine, butterine, and the various lard compounds. The experiments herein reported were undertaken for the purpose of comparing the digestibility of cotton seed oil with that of other vegetable oils and for comparing the vegetable oils with the more commonly used animal fats. The work was confined to the pure unmixed oils and fats such as are commonly used, either alone or in combination, as articles of human food. Some experiments are on record in which it was sought to determine what advantage, if any, pure butter has over oleomargarine in point of digestibility and consequent food value. Mayer and Jolles state that the two articles are equally digestible, and consequently are of the same food value. In this opinion they are supported by Lührig, who found, by a test lasting three days on a man 30 years of age, that 97.86 per cent of total butter eaten and 97.55 per cent of the total oleomargarine eaten were digested. Kienzel did somewhat similar work, using butter, lard, and oleomargarine and mixtures of these with various oils with results slightly in favor of the unmixed butter and lard. König and others deny that they have the same degree of digestibility.

The first of the following experiments were made during the winter of 1900-1901 with the following oils: Lard of domestic manufacture from the fat of young, corn-fed hogs, olive oil of unquestionable purity, refined cotton seed oil and crude cotton seed oil. Mice were selected as the animals with which to make experiments. For several days before the preliminary feeding began, the mice were kept in a room the curtains of which were kept closely drawn in order to place them as much as possible in their natural surroundings and thus overcome to some degree the effect of their imprisonment on the action of their digestive organs. At the beginning of the preliminary feeding they were very wild and restless, but they afterwards became more gentle, and while they were almost constantly in motion, they did not appear to be much annoyed by one's presence near the cages. Their almost constant moving about in the cages doubtless served to a considerable extent as exercise and probably decreased the effect of such close confinement on the normal digestion of the food. The mice were confined in cages made of wire cloth having a mesh about three-eighths of an inch square, the floor of the cages being of the same material. These cages were supported on pins at about one-half inch above the bottom of a tray into which the excrement and uneaten food fell and remained as dropped until collected each day, separated and preserved for future analysis. No attempt was made to separate and preserve the urine, as this would have been impossible and was unnecessary, as the digestion of the nitrogenous matter was not under consideration. It was not thought necessary that the vehicle for conveying the fat into the intestines of the animals should be absolutely fat free, but was considered sufficient that it contain a minimum amount of fat and in addition thereto, sufficient amounts of carbonaceous and nitrogenous matter to, at least, partially balance the ration and prevent to some extent the evil results produced by an entirely fat food. Patent flour, having a fat content of .90 per cent, was the material selected with which to mix the oils in the preparation of the foods for the tests. The various oils were mixed with the flour and sufficient distilled water to make a stiff dough, which was carefully kneaded to mix the oils throughout the mass. This dough was then baked in an oven and preserved in glass stoppered jars. A careful record was kept of the weight of food fed, the weight of the uneaten residue and the weight of the excrement. A preliminary feeding of five days preceded the feeding proper, which was continued for a period of eight days. The preliminary period and the end of the experiment period were marked by mixing a small quantity of finely powdered yellow ochre with the food and separating the excrement by the difference in the color. Water was kept constantly before the mice, the arrangement being such that they could drink at will and yet not drop particles of food into the cups containing the water.

The following table exhibits the per cent of fat in the food, the weight of fat eaten, the weight of fat in the excrement and the weight and per cent of fat digested in each pen:

TABLE I (Oils Cooked).

Kind of Fat Fed.	Refined Cotton Seed Oil.		Home-made Lard.		Olive Oil.		Crude Cotton Seed Oil.	
Number Pen	1	2	3	4	5	6	7	8
Per cent of fat in food	12.60	22.30	10.32	15.52	11.73	22.02	24.50	19.79
Grams of fat eaten	4.3269	9.0169	4.0668	5.7974	4.9545	10.6875	12.4349	8.6195
Grams of fat excreted	.2406	.1847	.1149	.2057	.1631	.1370	.3776	.1893
Grams of fat digested	4.0856	8.8322	3.9519	5.5917	4.7914	10.5505	12.0573	8.4302
Per cent of fat digested	94.43	97.95	97.17	96.45	96.70	98.71	96.15	97.80

As may be seen from the above table, in this experiment the amount of fat eaten varied directly with the per cent of fat in the food, but not in the same ratio. Also that the per cent of fat digested in the pens receiving refined cotton seed oil and olive oil is highest in the pens receiving the food containing the highest per cent of oil, while in the pens receiving crude cotton seed oil and lard the highest digestibility is found in the pens receiving the food having the lowest percentage of oils. Futhermore, the refined cotton seed oil and the olive oil gave the highest digestibility in the pens where the largest amounts of the oils were eaten, while the crude cotton seed oil and the lard gave the highest digestibility in the pens consuming the lowest amounts of the oils.

The general appearance of the mice during the experiment, and especially toward the close of the period, indicated that they were not receiving the proper food to keep them in a condition of thrift and health. In pen number four, receiving bread with 15.52 per cent home-made lard, one mouse died at the end of the eighth day of the feeding period and another died from the same pen four days after the experiment was concluded, and the food changed to a ration of corn and wheat. The first mouse that died appeared to be suffering from some severe internal pain. The flanks were very much drawn and were constantly thumping. Breathing was apparently very difficult. Its appetite continued good until a few hours before death. The other did not show any of these symptoms, as it gradually grew weaker, and while its breathing remained regular it refused all food for about twenty-four hours before it died. The other mice in this pen resembled those in the other pens, becoming shaggy in appearance and thin in flesh, but at no time did there seem to be danger of immediate death. Shortly after they received the first feed of the oily bread the mice became very greasy, apparently due to the oil adhering to them from contact with the greasy bread. It is possible that this would constitute one source of error in the results, but no means could be readily devised for preventing it. The error from this source is probably so small that it is not worthy of consideration. Too much stress should not be placed on the fact that two mice died from the pen receiving the food containing the highest per cent of *lard,* for it is not definitely known that these deaths were due to the character of the food eaten, although no other cause could be discovered to which they could be attributed. It is rather singular that no deaths occurred in the other pens.

The second experiments with these fats were made with guinea pigs to test the accuracy of the results obtained with the mice and to determine to what extent those results were applicable to other animals. It was considered advisable to extend the investigations to other oils that have promise of usefulness in the preparation of salad and cooking oils and in the manufacture of lard and butter substitutes. The pig feeding experiments conducted by Director Bennett, of this Station, and reported in Bulletin No. 65, made it desirable to determine the comparative digestibility of hard and soft lard.

This trial was therefore made with the following fats and oils: Pure home-made lard from the fat of young, corn-fed pigs, soft lard from the fat of home-grown pigs, beef suet, two grades of refined cotton seed oil (one heavy and one light), corn oil, peanut oil, pure American olive oil and crude cotton seed oil. The melting points of the lard and beef suet, as previously determined, were found to be as follows: Home-made lard, 36.9 degrees Centigrade (98.5 Fah.); soft lard, 27.0 degrees C. (80.2 Fah.), and beef suet, 44.9 C. (112.8 Fah.). Several unsuccessful attempts were made to provide a ration by mixing the oils with an entirely fat free substance, but the pigs persistently refused to eat each ration thus prepared, even refusing to the extent of starvation and death. As a last resort the oils to be tested were thrown in a fine spray over a quantity of bran having an original fat content of 5.86 per cent in the dry matter. The bran and oils were then well mixed, placed in glass jars and a quantity fed each day. The guinea pigs were confined in cages arranged on the same plan as was adopted for the mice in the first work. The experiment covered a period of six days and was preceded by a preliminary feeding period of ten days. The pigs ate greedily throughout the entire period and showed no evil results from having eaten the food for that length of time. On the last day of the preliminary feeding one of the pigs in the pen receiving crude cotton seed oil died. No reason could be found for its death. The day after the experiment closed one of the pigs in the pen receiving soft lard died with symptoms similar to those described in the case of the mouse which died in pen No. 4 in the first experiment. Post mortem failed to reveal the cause of death, although very slight indications of pneumonia were perhaps present. Table No. 2 is an exhibit of the kind of fat fed, the per cent of fat in the food, the weight of fat eaten, excreted and digested, and the per cent of fat digested in each pen. No corrections were made for the fat originally present in the bran, since the effect of the presence of this fat was in all probability practically the same in the different pens and the final results are therefore comparable.

TABLE II.

(FATS NOT COOKED.)

Kind of Fat.	Olive Oil.	Beef Suet M. P. 44.9.	Crude Cotton Seed Oil.	Soft Lard M. P 27.00.	Peanut Oil.	Refined Cotton Seed Oil, Heavy.	Hard Lard M. P. 36.9.	Refined Cotton Seed Oil, Light.	Corn Oil.
Per cent fat in food ..	12.36	13.32	11.70	11.14	11.90	10.76	11.38	12.64	12.66
No. grams of fat eaten	28.7741	28.9143	17.5755	23.3536	25.1760	23.7201	23.6238	23.9909	29.5094
No. grams of fat excreted.	3.4291	6.6153	1.6691	2.6192	3.5805	2.2584	6.1705	2.5907	3.9932
No. grams of fat digested	25.3450	21.2990	15.8064	20.7344	21.5955	21.4617	17.4533	22.4002	25.5162
Per cent fat digested..	88.81	73.66	89.93	88.78	85.77	90.47	73.88	93.37	86.47

The same relationship does not appear to exist between the amount of fat eaten and the amount digested in this trial as existed in the trial with the mice. In the trial with the pigs the greatly increased quantity of the oils eaten would materially decrease the effect of such unavoidable errors as may have been introduced into the results. In both cases the refined cotton seed oils take high positions in the scale of digestibility. In the second trial, in which hard and soft lard and beef suet were tested, the results indicate that the percentages of digestibility are higher as the melting point of the fats are lower. The difference in the co-efficients of digestion of the hard lard and beef suet is not as great as might be expected from the difference in their melting points, and is not as great as was found for the same number of degrees difference between the melting points of the hard and soft lards. It therefore appears to be true that the digestibility of a fat decreases as its melting point increases to a point near the normal temperature of the animal body, but that the influence of increasing the melting point of the fat on its digestibility becomes less as the melting point approaches to or exceeds the body temperature.

Since the fluid condition of the oils is due to the excess of olein which they contain, these results do not harmonize with the theory advanced by Connstein, that the digestibility of a fat or oil varies directly with the ease with which it may be saponified. In both these tests the more fluid oils showed the greater digestibility, and in the experiment with the hard and soft lards and beef suet it appears that the digestibility increases directly with the increase in the per cent of olein present. Olein is the most difficultly saponifiable of the three tri-glycerides found in largest quantities in these fats. One possible explanation of the apparently greater digestibility of the refined cotton seed oils and the olive oil is that there is present in the crude oils some substances, that are removed from the oils in the refining process, that act injuriously on the digestive organs, impairing their powers of digestion. These substances are possibly free fatty acids which are found in larger quantities in the crude than in the refined oils. The effect of the presence of these acids is a matter of dispute, some writers asserting that they are beneficial and others claiming that they are harmful. This will hardly explain the difference between the digestibility of the hard and soft lard and beef suet, nor between the animal fats and the vegetable oils when considered as distinct classes. A more plausible explanation is that there is present in the refined oils and the softer lards, a larger per cent of olein and a relatively smaller per cent of stearin (or palmatin) than in the crude oils, and the harder animal fats, and that the refined oils and soft fats are made more digestible on account of the possibly greater digestibility of the olein.

The results of this work are interesting in relation to the pork production experiments reported in Bulletin No. 65, of this Station. In those experiments pork was produced more economically by a system of feeding on crops gathered by the pigs themselves, than by feeding corn. The lard, however, from pigs fattened in this way was very soft, and was therefore considered inferior in quality. It was found by trial that it could not be profitably hardened by subsequent corn feeding to such an extent as would bring the lard up to the standard hardness of lard from corn-fed hogs. It now appears, from these digestion trials, that this hardening is done at the expense of the digestible parts of the lard, thereby making the firmer grades of lard more expensive than the softer grades, first from the greater expense of producing it by corn feeding, and, second, because the amount of available food or energy is less in the hard than in the soft lard.

It is apparently true, in the cases before us at least, that cooked fats and oils are considerably more digestible than those eaten raw. In cooking a fat there is probably more or less dissociation into glycerine and fatty acids, which if the theory is correct that the presence of fatty acids is conducive to a more perfect digestion of the fat, will help to explain the higher percentages of digestion in the experiment with the mice. In that work the oils were cooked in the preparation of the food, while in the work with the pigs the oils were fed raw.

Nothing developed in these experiments to indicate that the vegetable oils used are in any manner inferior to the animal fats as articles of food. In heat producing power the two classes are equal, while the vegetable fats appear to have been more completely digested. It is popularly believed that a cold, hard fat is preferable for shortening pastry, on account of the peculiar crispness which is imparted by its use. It is entirely probable that the softer fats or the oils would be equally as good if used under the same conditions.

It must be left very largely to the fancy of the individual consumer to decide which class of fats is to be preferred. W. Mattieu Williams says: "When common sense and true sentiment supplant unreasoning prejudice, vegetable oils and vegetable fats will largely supplant those of animal origin in every element of our dietary" (Chemistry of Cookery, page 109).

The results of this work are summarized briefly below. Digestibility of oils are as follows:

Kind of oil.	Average of two tests fed cooked to mice.	One test fed uncooked to guinea pigs.
Home-made lard	96.81 %	
Home-made lard, soft, melting point 27.0 degrees C.		88.78 %
Home-made lard, hard, melting point 36.9 degrees C.		73.88 %
Beef suet, melting point 44.9 degrees C.		73.66 %
Refined cotton oil, light	96.19 %	93.37 %
Refined cotton oil, heavy		90.47 %
Olive oil	97.70 %	88.81 %
Peanut oil		85.77 %
Corn oil		86.47 %
Crude cotton oil	96.97 %	89.93 %

The cooked oils were more completely digested than the raw oils.

The more fluid oils and soft fats were more completely digested than the heavier oils or the hard fats.

The effect of an increase in the melting point of a fat on the percentage of digestibility becomes less as the melting point approaches or goes above the temperature of the body.

The vegetable oils are not inferior to the animal fats as heat producers and are equal or superior in digestibility.

PEACH GROWING IN ARKANSAS.

By Ernest Walker, Horticulturist.

The Experiment Station has been conducting several lines of experiments and studies relating to the cultivation of the peach in Arkansas. Studies at the station have been supplemented by visits to a number of the larger peach orchards of the state. A number of varieties were planted at the station soon after its establishment. These have been added to,—some taken out. There are at present some sixty varieties at the station.

There is now an unprecedented interest in the state in commercial peach growing, and a demand for information relating to the various details involved in the planting, care of orchards and marketing of the crop. Many interested are wholly new to the work, and often to the state, and are daily by letter and otherwise applying to the station for guidance. The needs of these have been in mind in the preparation of this bulletin.

Arkansas has sprung into prominence during the past few years on account of her rapid horticultural development. Twenty-five years ago there was little of promise. Cotton was king—only the rich bottom land had a value. The thin rolling land and the rough mountainous north and northwest section traversed by the Ozark and Boston mountains, was considered well nigh worthless. It was poor man's land—and to locate there meant all but starvation in the estimation of the prosperous cotton planter. At that time fruit growing was limited to a few trees, usually seedlings, about the home. That was before the days of spraying, and often the fruits in the lower section of the state were kinds illy suited to such localities. In consequence, reports were often not encouraging. It was long known that apples and peaches did well in the northwest and northern counties and on the higher elevations elsewhere, and there were some orchards planted of considerable extent. But the fruit had no value. Transportation was lacking, and who at that time would have thought of shipping "northern fruits" to northern markets? Apples locally were only 25 cents a bushel. With the coming of the railroads and their extensions, improvements, and refrigerator cars, the prospects became more encouraging, and shipping began. Good prices were realized, more trees were planted. Progress was slow for some years, but during the past fifteen years has been quite rapid. During the past four or five years development has been by bounds. Land values have risen, and on all sides one sees the evidences of prosperity and rapid forward movement. In 1897 the apple shipments principally from two counties had reached the number of two thousand car loads. In 1901 these same two counties shipped approximately 4,500 car loads, in addition to about two-thirds that amount which went to evaporators, affording about eight and a half million pounds of dried fruit. The winter of 1898-9 was intensely severe, and one of the severest ever known in the history of the state. It was discouraging. If so, the great fruit years of 1901-2 were to even greater extent encouraging. Interest in apple growing bounded to the highest notch, and in the time since, the number of apple trees planted, as well as can be estimated, has been more than doubled.

But interest in apple growing has been accompanied with development in another line. If the great crops of 1901-2 demonstrated the possibilities of the northwest and other elevated portions of the state for profitable apple production, it developed the fact also that the state has as great if not greater possibilities for commercial peach growing. Those years found the state with some fairly extensive peach orchards and numbers of plantings of smaller extent. The larger orchards shipped car loads, in some instances almost train loads. It was easy to get together carload shipments from smaller orchards at a number of points. They brought good prices. In numbers of instances owners made enough to pay off the entire cost of their place and cost of planting with half the area in peaches and had a handsome balance besides.

A small planting in Washington County, of trees ten years old and under good care, yielded at the rate of $180 per acre net at 50 cents a bushel, both in 1901-2. Instances of better returns could be easily multiplied. One of the most notable instances of large returns from a well-cared for peach orchard was that of Mr. M. S. Scott at Slatonville, who netted $10,000 in two years from a 30-acre orchard of 3 and 4 year old trees, $3,000 for 1901—and $7,000 for 1902. On the other hand, an orchard of equal extent, and equally favorably located, under the same climatic conditions, yielded nothing in the same years on account of inexperienced management. On the whole the results in 1901-2 were so very satisfactory in Arkansas that an unprecedented interest in peach growing has arisen.

In 1899 the census showed a total of 2,769,052 peach and nectarine trees in Arkansas (practically all peach). In 1899 the number of trees was 4,062,218. Since 1900 it is probable that the number of trees has been more than doubled, possibly the total extent of such areas has been trebled.

Besides the great increase in the extent of smaller plantings and the planting of new orchards of moderate extent, some very extensive orchard plantings have been or are being made. The largest of these known to the writer is the prospective planting of 5,000 acres in peaches near DeQueen by the Southern Orchard Planting Association. This company has already planted a considerable area and are pushing the work of planting as rapidly as possible. Some other immense plantings, though of lesser extent than the above, have been mentioned. Besides such, a number of new plantings of three and four hundred acres in extent have sprung into existence.

The interest in peach growing amounts almost to a rush. Under the conditions prevailing there will no doubt be considerable ill-advised planting by persons of no experience, and by those who are always on the hunt for a ''pick-up''—a paying business that does not require business attention. There are some who believe that any fool can farm, (and that includes such things as commercial peach growing). While that was often true under the very favorable conditions of early days, I have yet to see the fool who, under the conditions of to-day, can demonstrate it..

WHO ARE LIKELY TO SUCCEED.

They who take up commercial peach growing as a business will likely succeed. They who jump into it simply as a speculation are more than likely to lose out in getting to the point where the first class begins. In the pioneer days of an industry there often seems to be some of the element we term ''luck,'' though in reality it is usually coupled with the faith and prayer of foresight, good judgment and pains. But be that as it may, later on when the world has heard the story of ''good luck,'' there is abundant competition and the chance element vanishes. The field becomes one of struggle—systematic struggle—commercially known as business—a field where survival means fitness, and fitness may mean survival.

Profitable commercial peach growing is a different thing from providing for a family supply, and they who take it up should in turn be taken up by it. It should occupy their time, their thought, their interest and intelligent efforts. It should become, not a side branch of farming, but the main business.

To simply plant peach trees and wait will not produce a profitable orchard. To produce a good peach orchard, maintain it and market the crops to the best advantage, costs something—demands continuous and intelligent care, fondness for the work, energy, good judgment and business methods. They who can meet the requirements are likely to find commercial peach growing a profitable employment, but those whose only pleasure in the work is limited to the jingle of the dollar had better form a partnership with inanimate things.

LOCATION FOR PEACH GROWING.

For family use, peaches can be grown with more or less success in most parts of the United States. They can be grown on soils of diverse character. For commercial purposes, however, careful attention must be given to the choice of conditions favorable to the crop and its best development with reference to marketing, shipment, etc. There are various important details to be considered, but the choice of location and soil is one of first importance. The key to an intelligent solution of this question is (1) the character of the tree, (2) the character of the crop.

THE TREE AND CROP.

Although a strong feeder and grower under favorable conditions, the peach is of a delicate constitution, sensitive, responsive, hateful of caprice, suffering under adverse conditions; yet possessed of remarkable recuperative power. The tree itself is quite hardy in soils which produce firm, well ripened wood, and in situations guarded against rapid alterations of heat and cold, and dry cold winds. The tree under such conditions can endure 20 degrees below zero. Indeed, has been known to endure a temperature as low as 28 degrees below zero and bear fruit the following season. The flower buds, however, are often winter-killed under conditions which leave mere leaf buds unharmed. The greatest weakness of the tree is its sensitiveness to warmth while dormant. Brief periods of warm weather during the dormant season often cause a swelling of the flower buds, and their destruction. Again this same responsiveness causes the trees to awake among the earliest of trees in the spring, and burst into bloom, when an untimely frost or freeze soon makes short work of rosy promises.

The crop is one of the most perishable grown—selling by its attractiveness. It requires prompt, swift handling, yet must be touched lightly as eggs.

Aside from the question of mere hardiness, in view of the nature of the tree and crop, locations for peach growing are selected mainly (1) with reference to escaping spring frosts, (2) with reference to marketing.

Much of the north is simply too rigorous for the peach, prohibiting its extensive cultivation except in limited and scattered areas. It does not thrive above the 44th parallel, and then, as in Michigan, only through the protective influence of a large body of water or other favoring conditions. Other northern peach areas are similarly dependent on influences which modify otherwise severe climatic conditions. At the South we escape the severity of the northern winters, but we suffer increased danger from frosts—late spring frosts, and the mild spells of winter so frequently followed by sharp and sudden freezes. Far south where the mildness of winter exempts the soil from freezing there is trouble from a knot disease of the roots due to nematode worms.

THE SITE.

Low lands are proverbially frosty; they are moreover liable to be of a character unfavorable to the production of peaches of fine color and quality. The fruit grown on such lands is also likely to be deficient in firmness and shipping value. The rolling lands and slopes are the most suitable and favorably situated for escaping the effects of spring frosts and freezes. This is on account of better atmospheric drainage. The cold air being heavier than warm air settles, flowing down the slopes and valleys onto the low lands. There it forms invisible rivers or lakes of cold air, greatly increasing the likelihood of frosts in the valleys and their severity. This was widely and conspicuously illustrated in the freeze of last May when dead herbage of trees and other forest growth marked the fatal frost line about one-third the way up along the hillsides, very noticeable in places along the railroads in northwest Arkansas from the car windows. All peaches were killed in the valleys, but in some instances escaped on the hill-tops.

Land may be flat, yet safe for peaches if there is lower land adjoining it, permitting the flowing away of cold frosty air to the lower levels.

ASPECT.

Some of the severest damage is done to trees by the rapid thawing following sharp freezing. The effects are still worse if growing conditions precede the freeze, and they may be neutralized by gradual thawing after the freeze. A south and southeastern slope is often trying on this account. It is warm earlier and more subject to sharp alterations of temperature. A southwestern exposure is better, being sheltered from the early morning sun. A gentle northern slope is most advantageous. Too steep, it lessens the color and quality of the fruit. The northern aspect tends to retard growth. It is a cold position, but it is not the cold that injures trees like the peach so much as the alteration of cold and warmth. The northern aspect secures greater uniformity in winter conditions.

SOILS.

The most favorable soil for peaches is a sandy soil underlaid with clay—preferably the red clay, rich in iron. It should have good drainage. Such a soil is warm, and not only favors a firmer, better ripened and hardier growth, but is necessary to fruit of the best color, quality, and shipping value. A hard-pan or wet soil is highly objectionable. Peaches will grow in soils of diverse character—even heavy soils, provided such have good drainage and are kept mellow. In such soils—strong soils, the tree grows taller and lives longer. They may be used for home or local market supply. For commercial peach growing, however, the lighter soils alluded to are beyond all question the most profitable.

LOCATION WITH REFERENCE TO TRANSPORTATION.

The peach crop is one of the most perishable grown, requiring prompt and swift yet careful handling. Lands remote from shipping stations, especially on rough roads, are therefore out of the question for large peach orchards, no matter how well adapted otherwise to peach growing. Just the distance it will be safe to go from shipping points depends on the character of the roads. Peaches are practically ripe when gathered and ripening continues rapidly in warm weather, so they need to be put in refrigerator cars and sent whirling to their destination as soon after gathering as possible. Four to five miles is about as far as one should go as a rule. Small isolated orchards are undesirable. Express shipment is unsatisfactory. The best profits are to be had only when shipments can be made by the car load.

Railroads will make liberal concessions and provide conveniences in the way of side tracks, shipping sheds and iced cars where the amount of business will justify it. They are anxious to encourage new industries along their lines because its pays them in more ways than one.

Planters must therefore grow quantities, or induce others to join in making numerous small plantings. Some excellent peach growing points are at present unoccupied because no one has realized their opportunity or led off in the work. Where a number of small growers are to be interested, and work for their common interests, some sort of an organization is a necessity. It seems more and more a necessity as production increases and the industry grows in order to market the fruit to the best advantage—indeed often to market it at all. Then one or more of the members, appointed for the purpose, may visit the markets and look after the interests of the shippers. Uniformity in grading, etc., may be secured by placing this matter in the hands of one or more men who will act with absolute impartiality in enforcing adopted rules and standards.

Lastly, the problem of labor must be considered and settled. There must be no delay when the time comes for gathering and marketing the crop. Where the interests are large, arrangements should be made to keep through the year a foreman with one to several assistants who have proved their efficiency, in case the employer's own family cannot furnish the frame work of the organization in work needed to handle large crops. After producing crops one cannot afford to fail in marketing. Yet the losses at such times are often large, sometimes amounting to 40 per cent of the crop.

THE PEACH BELT OF ARKANSAS.

Unquestionably there is much land in Arkansas suited to commercial peach growing. The state's position and facilities for reaching the great markets are excellent, but there are also considerable portions of the state wholly unsuited to the business. Peaches for family use can be grown in some parts of almost all counties of the state. The state presents a varied topography. From low lands lying along the Mississippi with an elevation of only 116 to 330 feet above sea level, there is a general ascent toward the northwest where the average elevation ranges at about 1,200 feet. In places there are much greater elevations. The more elevated lands occupy, roughly speaking, about the northwest quarter of the state. The Ozark mountains entering the state from the west and north give character to this section. South of this region and somewhat parallel with its southern border for a considerable distance, is the valley of the Arkansas. Across this valley southward and occupying the central-western part of the state, is another region broken by sharply elevated and mountainous ridges—the Ouchita mountains.

With reference to peach growing the state may be roughly divided into three sections, illustrated in the accompanying diagram:

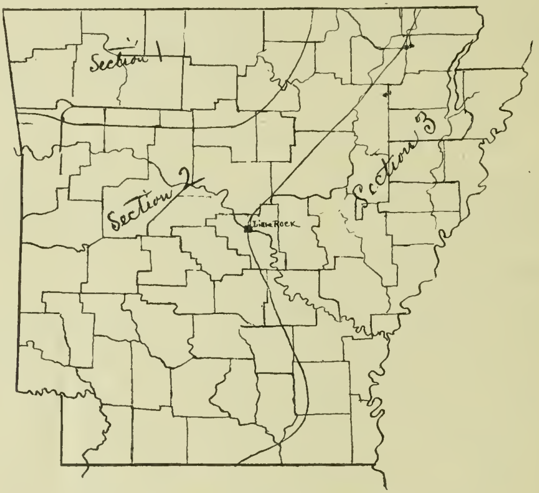

Diagram map showing peach belt of Arkansas.

The line cutting off section 1 in a general way cuts off that portion of the state with an elevation of 1,000 feet and over.

Section 2 has some mountainous elevations, as previously mentioned, but for the most part consists of rolling or hilly lands ranging in elevation from 350 to 800 feet. Some parts, especially southward, are too flat for best results with peaches for shipment.

Section 3 ranges in elevation from 116 to 360 feet, but is mainly low-lying land—considerable portions being subject to overflow from the Mississippi. Such lands are frosty and the peaches, when they escape frosts, though large and fine, are less firm and not so well adapted for shipping.

Section 1 in good fruit years produces peaches of fine quality, but as a rule is not so well suited for commercial peach growing as for the apple. For the most part the danger from winter killing of the buds and spring frosts is greater here than in section 2. Conditions afford one to two crops in five years. Still the crop is so profitable when it does "hit," that growers are willing to take chances on it.

In section 3 only the restricted elevated portions are at all suited to peach growing in a commercial way, for reasons previously mentioned. Crowleys Ridge, a sandy formation about 220 to 330 feet high, 7 to 20 miles wide and 125 miles long, is in the northern part. It extends almost northward and southward across several counties. It and Monticello Ridge, in the southeast, represent the best peach land in this section of the state.

The true peach belt of the state, in a general sense, is represented in the moderately high and rolling lands of section 2. In favored locations in this section the peach affords a crop on an average of about 3½ to 4½ times out of five years. The lands which have been found to be so admirably suited to the peach are in the main soils which were coming to be considered "worn out" for cotton. Some of the large and important plantings in this section are as follows:

At Van Buren the "Model Farm," 262 acres with 7,000 peach trees, belonging to Capt. M. F. H. Smelzer, who has been often called the "Peach King of the Ozarks."

"Pride of Crawford Farm," 80 acres with 7,000 peach trees, belonging to Capt. Smelzer and his cousin, George H. Smelzer.

"Oakland Farm," belonging to W. H. H. Shibley of Fort Smith and S. W. Stewart of Van Buren, containing 11,000 peach trees.

At Ozark Mr. A. W. Poole has extensive orchards, including apples and larger plantings of peach. His high mountain fruit farm includes some 400 acres. The H. T. Williams orchard includes about 6,500 peaches. The H. H. Hall orchard contains 4,000 peach trees and is being extended by the planting of 3,000 additional trees.

At Clarksville D. E. King of Little Rock and A. W. Ward of Clarksville are the principal owners of a peach orchard containing 220 acres in one block. It is stated that 100,000 peach trees have been planted in the vicinity of Clarksville during the last winter.

Greenwood, Sebastian County, shipped 140 cars of peaches in 1902, and it was expected that 1,000 acres would be set out in the spring of 1903.*

At Hackett is the peach orchard of M. S. Scott, Esq., and some other plantings, 30 cars were shipped from this point in 1902.

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* Ft. Smith News Record, Jan. 8. 1903.

In south-central Arkansas there is some excellent peach lands, and a company there has been formed at Eldorado to plant 300 acres.

At DeQueen, in Sevier County, are the extensive plantings of the Southern Orchard Planting Association, of which E. M. Treakle of Kansas City, is manager, and Mr. Bert Johnson of DeQueen local manager. This association now holds 5,370 acres, of which a large part is to be planted to peaches. Among others at this point interested in peach growing are John A. Nelson, S. H. Nelson. Near Mena the Stillwell orchard contains 5,000 peach trees. Other more or less extensive plantings of peach near Mena are those of A. W. St. John, G. D. Bratschi and Dr. W. F. Mills.

A great many peach orchards have also been planted in the north and northwest portions of the state along the Frisco and its branches, Kansas City Southern and St. Louis and N. A. R. R. These are too numerous to mention in particular. The value of land on which peaches are grown varies according to improvements. Location, proximity to towns, shipping points, etc. Rough, uncleared lands or partially cleared range from $2.50 to $15.00—improved from $15.00 to $100.00. In general land suitable for peach growing and fairly well located changes hands at $5.00 to $25.00 an acre..

The new census, especially were it taken in the next year or two, will show a large increase in the number of peach trees planted in Arkansas. The actual increase, however, is less than the apparent increase, since many of the orchards planted will no doubt meet with neglect, ill-advised care and final abandonment.

VARIETIES.

The experience of growers in Arkansas has been that medium and late varieties are most profitable. The earlier varieties were tried some fifteen or twenty years ago, and were tried again later, but they proved unprofitable. In Georgia a number of varieties preceding Elberta are now being grown and shipped. Earlier, however, their experience was similar to ours. Their present success is due to the great improvements for the cheap manufacture of ice, the modern refrigerator car, and prompt railroad service, and a better realization on the part of the railroads of the immense value of such industries. Only eight years ago seventy-five per cent of the peaches being planted in Georgia were the Elberta—later the desirability of extending the season has led to the planting of a number of other varieties, chiefly preceding Elberta, and including the earliest varieties known.

The list of commercial peaches grown there at the present time includes in order the following: Greensboro, the earliest really good peach to find its way to northern markets, followed by Waddell, Hieley, Carmen, St. John, Mountain Rose, Thurber, Belle of Georgia, Elberta, Stump, Emma, Frances,—the two last rounding out the season from the 1st to 10th of August. The Georgia State Horticultural Society includes also Red River, Tillotson, Early and Late Crawford. Triumph, a variety planted largely for a few years, is not valued recently on account of its susceptibility to rot.

It is possible that our failures in Arkansas with early peaches were due to the conditions of the time, and the then insurmountable difficulties in shipping, and to the poor quality of the varieties, such as Alexander, Early Rivers, Amsden, Hales, etc. It is probable, however, that even under improved conditions and with better early varieties, we are still at great disadvantage in the matter of early varieties. Georgia and other southern plantings are increasing immensely. Georgia is more than a month earlier than northern Arkansas and somewhat earlier than even southern Arkansas for a given variety. Lower Texas is even earlier than Georgia. The following are approximate dates of ripening for the Elberta in several localities:

S. E. Texas, latitude 30 deg. 30 min., July 10.
Central Georgia, latitude 32 deg. 30 min., July 15.
S. W. Arkansas, latitude 34 deg. 55 min., July 25.
N. W. Arkansas, latitude 36 deg. 5 min., Aug. 15 to 20.
*St. Louis, Mo., latitude 38 deg. 40 min., Aug. 20.

Georgia and Texas have not only the start in the early peach business, but the advantage in earliness for all varieties.

Southward of us conditions are less favorable to the latter varieties,—northward they are more favorable for such save for the fact that there the crop more often fails or is short. Analysis of the situation therefore throws light on Arkansas experience in the matter of varieties, and points to the probability that it will be the same in the future; viz., that our best field is mid season and later varieties. Mountain Rose and Family Favorite are probably as early varieties as will prove generally profitable planted in shipping quantities.

The shipping peach must be of good size, of handsome color and good shipping or carrying quality. They must be firm, and retain their firmness for some days. The chief demand at the present time is for yellow free stones. But there is likely to be a better market

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* Central Missouri has only about one-third the altitude of N. W. Arkansas.

for white free stones of good quality hereafter, simply because it is human nature to tire of one thing, no matter how fine or satisfactory it may be. There is already some opening for clings. The chief demand for such, however, is late in the season. The yellow clings are preferred by canneries. The white clings are readily salable for canning, pickling and preserving.

The commercial orchard should be limited to few varieties, not over six to ten, while three or four will answer. Of these there should be large plantings of single varieties to load cars, one variety to a car. The best and final index to varieties is local experience. The intending planter should consult with growers in his neighborhood. The Elberta so far has been planted here almost exclusively. It is among peaches what the Concord has been among grapes. Growers, however, should plant a few other varieties of different seasons, say one or two, from two to three weeks earlier than Elberta, then two or three others following the Elberta at intervals of two or three weeks. It will be desirable to let from one-half to one-third at least of the plantings be other varieties than Elberta, avoiding as a rule, however, the very early varieties. It is better for the commercial peach grower to adhere to the old and well tried varieties whose records are known. If newer are tried it should be only in an experimental way until their merits are established.

For Family or Home Market.

The following varieties, mentioned in order of ripening, are leading kinds: Sneed, Triumph, Carmen, Mountain Rose, Family Favorite, Early Crawford, Champion, General Lee, Elberta, Mixon, Late Crawford, Emma, Mathews' Beauty, Stump, Piquet's Late, Heath Cling, Salway, Henrietta.

For Shipping.

The following have proved valuable for market,—in order of commercial value,—Elberta, Salway, Mountain Rose, Emma, Family Favorite, Heath Cling.

Slappay, a new kind, preceding Elberta about eighteen days, is too new to report on, but is worthy of trial. Mr. M. F. H. Smelzer at Van Buren has a trial commercial planting of this variety. It is also being grown and shipped in Alabama and Georgia.

Mathews' Beauty, following Elberta about two weeks, is also a promising variety. Both are yellow free-stone peaches, resembling the Elberta.

FERTILIZERS AND PREPARATION OF THE LAND.

Much of the land on which the peach has been found to thrive admirably in the south is the rolling and worn cotton soil. Although so worn as to be unprofitable in cotton, these lands are by no means "worn out" for peaches. Only the surface soil is exhausted, under the shallow system of cultivation usually practiced. Peach roots run deeper and the land is commonly deeply prepared in preparation for the peach orchard. The result is that fertility buried beyond the reach of cotton is rendered available for the peach. Later on, however, as a rule, additional plant foods are required for large crops. Since peach growing has awakened so great an interest plantings are not limited to the old soils, but new land is being cleared and planted as rapidly as cleared. Some growers advocate this practice. There are strong reasons, however, for preferring old land, even if won, to raw new land. If practicable new land should be cultivated two or three seasons in farm or other crops to bring it into a more favorable state for orchard trees, and to enable the operator to discover the wet spots, poor spots, and to remedy them. Such lands ordinarily contain an excess of nitrogen and need to be exposed to the mellowing influences of the air and sunshine, while a crop like corn is beneficial in getting rid of the surplus nitrogen. Worn soils in the south are deficient in nitrogen and humus. The nitrogen has been used up and leached out, while the humus has burned up under the usual system of cultivation. Such soils in preparation for peach orchards will be helped greatly by cultivation in some legume, such as cowpeas, to be turned under. Rye and hairy vetch or crimson clover make a good winter cover crop to succeed the cowpea. They are turned under as soon as the ground can be prepared in the spring. Ordinarily, however, the grower will not wait,—preferring to plant at once. In this case if the land be very worn it will be necessary to make use of some fertilizer broad casted and worked in, or applied around the trees at least. The best results are obtained by a thorough incorporation of insoluble fertilizers with the soil as deep as the turning plow runs. This encourages a deeper running root system in the tree. Insoluble fertilizers applied merely to the surface work downward slowly, and tend to encourage surface roots, thus rendering the tree more subject to the injurious influences of drouth. A mixture of bone meal, acid phosphate and muriate of potash, equal parts of each applied at the rate of 400 to 600 pounds to the acre, has been found a very good fertilizer for the purpose. It is preferably applied in the fall.

When the trees reach bearing age the mixture for one annual application may contain a third more of the muriate, while the amount of acid phosphate may be doubled. Every four or five years ashes, provided they are obtainable, may take the place of the muriate. In addition to potash they supply considerable lime, which is beneficial to the peach, as well as helpful to the subsoil. Ashes may be used at the rate of four to eight tons to the acre, according to the quality of the ashes; less of unleached hardwood ashes being required than of soft wood or of leached ashes.

Stable manure as a rule is undesirable in peach orchards. If used it should be applied with caution. Its tendency in quantities, as of other slow acting forms of nitrogenous fertilizers, is to stimulate a late growth and over luxuriance and diminish fruitfulness. It may be used on very poor land, or sparingly in bearing orchards when the feeble growth, early maturity of wood and yellowish foliage shows a need of nitrogen. In the case of peaches it is quite as important to guard against excess of nitrogen as to supply a deficiency.

After the application of fertilizer as above suggested, cowpeas, or other legumes to be turned under the following spring, may then be grown among the trees, leaving a space of four feet on either side of the trees. On worn land, and especially with close planting, it will be undesirable to attempt any crop for profit among the trees. If attempted the land should be fertilized for such a crop, and then only hoed or cultivated crops are to be considered, such as cotton, beans, tomatoes, melons, strawberries. Corn is often used, but it is a gross feeder and is less desirable. Melons are somewhat objectionable as they do not conveniently admit of the complete continued cultivation needed during the growing season of the peach. Cotton or strawberries are excellent.

While deep preparation of soil is necessary, on thin soils it should not be done wholly with the turning plow. It would be undesirable to turn under the shallow soil and bring to the surface the subsoil, all at once. The subsoil plow following the surface-working turning plow loosens the subsoil to a depth of six to ten inches deeper without throwing it to the surface.

Surface plowing should extend six to eight inches deep. Subsoiling should be done in the fall. The best plan is to thoroughly and deeply prepare the land before the trees are set and during the first year following planting. After the roots of the trees occupy the soil deep plowing is injurious. When time does not permit of deep preparation of the whole area previous to planting the land may be deeply prepared in strips six or eight feet wide where the rows are to run, the intervening spaces to be broken and subsoiled later or during the following fall.

Some writers for the horticultural press contend that deep preparation of the soil for orchards is unnecessary, even a detriment. There are doubtless local conditions where such may be the case. In such matters general and not local experience should be the guide for others. The results of thorough preparation, and thorough tillage versus the contrary, have too often demonstrated the advantages for opposing opinions to carry much weight. Frequently such writers make some allusion to "Nature's ways," of "conditions in the forest," or splendid results without spraying, or in spite of neglectful methods, which should with thoughtful people at once condemn their views as superficial.

THE TREES TO SET.

Peach trees are propagated by budding the improved varieties on stocks raised from seed. A single leaf bud from a twig of the choice kind is inserted under the bark of the seedling near the ground, the opening in the bark being made by a T shaped cut. The place is then bandaged firmly with string, bast-bark or raffia tying material —leaving the bud proper free and exposed. If successful the bud will have united with the stock in fourteen days, when the bandage should be cut. The operation requires that the bark "slips" readily. Seedlings about the diameter of a lead pencil are the most convenient size for budding. The operation is performed at two seasons, in spring and fall, making what are known as "June buds" and "fall buds." In the former case the stock is cut off above the bud after the union takes place, and the inserted bud starts into immediate growth, making a small tree the same summer. In fall budding the stock is not cut off until the following spring, the resulting tree having the entire summer before it makes a larger growth than the June bud, being a yearling at the end of the season. Care must be used in selecting to avoid flower buds. Leaf buds are smaller and pointed. The buds used in budding, it is conceded by good authorities, should be carefully selected from bearing trees of good record, and free from disease. There are only a few varieties which reproduce with any degree of certainty from seeds, and in these instances it is by no means that the assumption is correct. The Heath Cling is one of these kinds, but as is known there is an endless array of stuff sold under the name of Heath Cling which apparently have come into existence through the supposition that the White Heath comes true from seed. There is no such thing as an improved variety coming absolutely true from seed in all the seedlings, no matter how large a percentage of the seedlings may closely resemble the parent. It is the height of folly for one who thinks of growing peaches for market to plant seedlings or for any purpose, except for stocks to bud on, or with a view to originating new varieties, because of the tendency to vary when grown from seed, and the inferior character of seedlings as a rule.

June budding is practiced principally in the south. For orchard purposes yearlings or June buds are preferred to larger trees. Some of our larger planters prefer the latter, or second grade yearlings. June buds are commonly well branched close to the ground, and more stocky than the yearlings, and in good shape for heading. As a rule it is cheaper to buy the trees than attempt to grow them. They should be obtained from some nursery-man of known skill and reputation, and as near home as possible.

Some orchardists in Arkansas have suffered heavy losses through purchasing trees which proved untrue to name. If discovered early, or if headed back to get young wood, such trees may be top-budded to a desirable variety.

Upon the receipt of a shipment the trees should be carefully examined to insure their being free from borers, root-knot or crown gall, and scale insects or bark lice. Nurserymen, in accordance with a recent law,* should be required to attach to each lot and package of nursery stock the certificate of inspection or fumigation of an official (State or Experiment Station) entomologist or inspector. And then it should not be taken for granted that the trees are absolutely free from disease or insects, but they should be given a careful examination by the purchaser. Should anything of suspicious nature be discovered on the trees in the way of galls or insects, if doubt as to its character exists, a specimen, with a statement of the extent of its occurrence among the trees may be sent to the Entomologist of the Experiment Station at Fayetteville, who will give suitable advice.

The bark of trees in good condition should be bright and fresh. Trees are sometimes in poor condition from exposure to wind and sun at the nursery after being dug, and from drying out en route in consequence of poor packing. Last year samples of a lot of 3,000 trees sent to the experiment station were found to be wholly unfit for planting, the heart wood and that of the roots being black, as a result probably of being frozen in shipment. These trees were large and over luxuriant.

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* Law passed by last General Assembly and approved by the Governor May 20, 1903.

In Arkansas, especially in the less elevated parts, trees may be set at any time from the fall of the leaf to the following spring when the ground is not too wet, or dry, and the weather is mild. In exposed situations, and at the north, spring setting is to be preferred.

In case the trees have to be healed in, the bunches should be loosened, the tops should be leaned toward the south, and mellow earth worked well in among the roots. This is particularly important in case the trees are to be held for spring setting.

PRUNING THE YOUNG TREE.

In this climate the preference is for low-headed orchard trees. The form of tops is a matter upon which views differ. The vase form, however, is a desirable shape and is the form usually prefered. This method of training seeks a well distributed system of branching in the bearing tree, leaving the crown of the tree rather open, with the view of securing for each branch the maximum amount of light. Preparatory to securing such a shaped head the young tree is severely pruned back at the time it is set. The stem is cut back to about eighteen inches—side branches, if present, are cut back to mere spurs an inch or less long. The peach is a rapid growing tree. Branches will push out vigorously the following spring. These will readily attain a growth of three to six feet. Some will start too low and should be removed. Three or four of the branches should be selected to form the frame work of the tree. These should be distributed at different heights on the stem, and on different sides of the tree. Interfering branches and any which tend to form V-like forks are removed, as in the latter case the trunks are liable to split when the trees have come to bearing. The following spring, the branches, if very strong, may be cut back to two and one-half or three feet. If weak they may be cut back half or more. The pruned limbs will branch freely, and two or three of the side branches near the end are selected to form the vase shaped crown. These are cut back the following year, and others pruned back about one-half or removed altogether if crowding. The tree may bear some fruit this year and this fact should be kept in mind when pruning in order that all bearing wood shall not be cut away. On this account it will be well to delay the pruning until after the blooming period.

The roots of young trees always suffer more or less in digging. In setting the trees there are two general methods of root pruning. In one method only bruised or injured portions are removed, the effort being to maintain as nearly as possible all the roots. The other method is a system of very close root pruning. It has for its object the development of a new root system in the particular place where the tree is set. It also facilitates planting, and is economical of time and labor in planting where conditions make it practicable. Mr. H. M. Stringfellow of Texas has been a staunch advocate of close root pruning. It has proved highly satisfactory in many instances, but is not adapted to all conditions. Results of trials at the Arkansas station have been less satisfactory than planting with only a moderate pruning of the roots. The method, however, is very satisfactory in the sandy soils of the south, when the water table is not too deep. It is extensively used in Georgia. In general the method succeeds better at the south than at the north,—in sandy soils than in clay,—with small trees better than with large.

Trees so pruned have the side roots cut off to stubs one inch long, and the main root shortened back. If pruned before shipment the stubs should be longer to be cut back sufficiently when planted. In planting it is only necessary to make an opening by thrusting a spade in the soil, working it backward and forward, inserting the tree, and then pressing the soil against the root by thrusting down the spade beside the tree, as in making the first opening. The soil is pressed firmly against the root. The feet finish the operation. Whatever method is used, great care should be given to pressing the soil firmly about the roots. With care in this detail losses from dying are reduced to almost nothing, in the case of trees planted in the ordinary manner, even should drouth follow.

The trees should be set some deeper than they stood in the nursery, especially on slopes where there is liability of the soils washing away to some extent.

DISTANCE FOR PLANTING ORCHARDS.

Various distances have been tried and recommended for peach trees. As close as 12x12 feet and less, has been tried under systems of close pruning. Hale has large commercial plantings as close as 13x13 feet and 15x15 feet. The ''filler system'' sometimes used in apple orchards has some advocates. So planted the distance given is 12x16 feet, with the view of removing the close row when the trees begin to crowd, which will be in four or five years. The rectangular system is similar to the above, but with greater distances, and the idea of retaining all the trees. The distances most suitable for this plan on the thin soils, southward, are 18x20 feet. Some extensive growers who formerly practiced close planting more recently recommend greater distances, not less than 18x18 feet nor more than 20x20 feet. When the trees receive careful attention in the way of pruning or shortening in every three or four years the closer distances may be used, otherwise they should have 20 feet. At the south on our thin rolling and sandy lands there is frequent trouble from the tendency of soils to wash. The Terrace or Contour plan of planting will be desirable on such lands. The plan contemplates setting the trees along lines of uniform level around the slopes. The distance apart of these lines varies according to the steepness of the incline. On steep slopes they may be closer. and their distance apart will also vary some according to the contour,—approaching here, wider there—in order to maintain the level. The slight irregularities in contour are ignored for an average level. The distance apart of the trees in the row will of necessity vary also more or less. The irregularity of the lines will occasionally necessitate a short row. Such lands are to be broken with a hillside plow, throwing the soil of a given terrace down hill. The line of level making the lower edge of the terrace is left unbroken, to be covered by the soil of the first furrow above it. Bermuda or other grass is allowed to grow along this line which further assists in protecting it against washing. In stony lands many of tthe large stones may be gotten rid of and put to use by distributing them along the terrace line, at the outstart, and covering them in the plowing. Trees planted according to this plan can be cultivated only one way.

PLANTING THE ORCHARD.

The method most commonly employed on fairly level land is to measure off accurately the distance between the rows all around the field, marking the ends of rows with pegs, and then lay off the land in squares by furrows running in opposite directions. These furrows correspond to the position of the rows, the trees being set at the points of intersection. A couple of tall stakes to use on opposite sides of the field in running the furrows should be provided. With a skillful plowman and careful work it is possible to secure very satisfactory results in this way. Waite describes a practical and more accurate method. Stakes and pegs are located around the field as just described:

"The pegs should be put a rod or two outside of the outer row of trees and parallel to it all around the block. These pegs may be quite small, split from a block of wood, and should be set accurately. A quantity of stakes should be made 4 to 6 feet long. The head man takes an armful of stakes and beginning at the peg back of tree No. 1 drives a stake accurately behind it. At the same time an assistant, stationed at the opposite side of the field, also carrying an armful of stakes, places a stake at his end of the row. A third man with a supply of stakes is stationed midway between these two, and after end stakes are driven the foreman sights between them and accurately locates the position of the middle stake while the helper drives it, thus setting the three stakes in line on each row. In the same manner the rows are staked out in the other direction. This is very quickly and accurately done unless hills are encountered, which are difficult to sight over, but by using a long pole for guiding the location of the stakes this difficulty may be overcome. The result is a stake marking each end of each row and a row of stakes across the center of the field each way marking the middle point of each tree row.

Taking the most convenient direction, the deep dead furrows are then plowed, and necessarily with them the center stakes, which must be reset by sighting. The trees are then brought into the field and the bunch of bundles required to plant each particular row, as shown by the plan on paper, is then roughly heeled in in the dead furrow at the end of the row. While up to this time considerable labor has been expended in preparation work, from now on the planting can proceed with great rapidity and accuracy. The planting gang should consist of four men, viz, the foreman, who holds the tree and tramples the earth around it; two shovelers, one of whom must be a good hand at sighting a straight row; and a fourth man, who prunes and drops the trees at about the places where they are to be planted. The foreman holds the tree in his hands in a vertical position and sights accurately its alignment with the center stake and the end stake beyond. The first shoveler stands in line with the cross row and sights on the center stake and end stake of that row. This results in easily placing a tree within an inch of where it should be. If any additional digging is necessary the two shovelers strike in with their shovels and remove the necessary earth. The tree is then set in place, and the mellow earth shoveled around it, the foreman tramping the soil firmly around the roots as it is thrown in. He keeps the tree in line on the row being planted, while one of the shovelers sees that it is kept in line in the other direction. In this way four good men can plant out easily from 500 to 1,000 trees in a day. When the planting is finished, a one-horse plow is used to fill in the dead furrows and to throw the earth more thoroughly around the trees.''*

PRUNING OF BEARING TREES.

The peach bears on the young wood of the previous season's growth. If growing properly the new twig growth of bearing trees should be from eighteen inches to two feet. Some growers, from the start, allow trees to run up about as they will, forming tall slender branched trees, and allow the trees to bear as they will. The best growers, however, prune vigorously, removing in addition to dead limbs all growth from the interior that tends to make the head too dense, and shorten in the annual growth from one-third to one-half, cutting off completely some of the terminal twigs when bunched. Short bearing twigs are encouraged along the sides of the main limbs by keeping the head fairly open. There should be a rather severe shortening-in annually after five or six years, leaving sufficient of the blooming wood of the preceding year's growth for a crop. The aim should be to preserve the form and keep the head low. With proper care it will not be necessary to cut limbs over an inch and a quarter in diameter. Wounds over half an inch in diameter should be painted or coated with tar. The best opportunity for severer heading back is an ''off year.'' A large growth will result which will need to be judiciously thinned out.

This method of training makes the fruit easier to gather, reduces windfalls, lessens breakage, secures better distribution, improves quality, gives better color, larger fruit, facilitates spraying. The annual shortening in of twig growth is equivalent to so much thinning of fruit. It cannot take the place of regular thinning of the crop, however. The twig pruning, or the pruning for fruit is best done about the blooming period and thereafter till the leaves are half grown. Earlier it may favor premature swelling of the buds. The heavier pruning for growth, in ''off years,'' may be done any time in the spring after severe freezing is over, until the growth starts.

When trees have been severely winter injured, as was the case in 1898-9, when the mercury fell to 26 degrees below zero, a vigorous cutting back may restore to vigor trees which would otherwise die, or gradually decline. Orchards so treated were not only saved, but in

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* Year Book U. S. Dept. Agr., 1900, pp. 373-374.

1901 and '02 yielded large crops, which proved immensely profitable, while orchards not cut back, not only produced nothing in those years but are in a feeble and dying condition. Newly set orchards that year were in many instances killed. When given up, such was the case, but where the trees were cut off within a few inches of the ground, the stumps sprouted up later from above the union and the entire planting was saved.

Large trees at the Experiment Station were badly injured the same winter. Severe cutting back has saved them and made fine shapely trees. When cut back only slightly the results were not so satisfactory. Although prevented from dying the trees remained feeble. In the case of only moderate injury the lighter cutting back would have answered. These trees were subsequently given another heavy cutting back. At the same time they were given a slight dressing of stable manure, and an application of hard wood ashes at the rate of four tons to the acre. The severest cutting was practiced on the weakest trees. Wounds were covered with tar. The trees have pushed out strongly, and have developed into fine topped trees, and are good for a number of years. With timely attention and care the peach is not necessarily a short lived tree but can be made to live and bear for twenty-five years or more.

CULTIVATION.

Theoretically the land planted in orchard should be given to the trees from the beginning. In practice, however, as a rule, this is impractical. The grower is obliged to get some income from the land while waiting for the fruit crop. The question then becomes which crop? What one can be grown to interfere least with the trees, while bringing in some returns? Strawberries, melons, cotton, were previously mentioned: (see Preparation of the Land, page 56), corn may be grown where land is rich, or sufficiently fertilized. Blackberries, potatoes, cabbage have also been used. The general rule is that any crop requiring cultivation is least objectionable for the first two years, but such crops as grass, grains should be rigidly excluded. As trees reach bearing age they should be given entire possession of the ground save for such crops as are grown to plow under and for winter cover.

Cultivation of the land after planting the trees is principally surface, tillage, to conserve moisture, keep down weeds, aerate the soil and liberate plant food. Where crops are grown cultivation will have to be by means of such implements as cultivators, etc., otherwise it can be done for the most part by disc, cutaway, the acme or spike-tooth harrows. The first plowing of the season, however, frequently necessitates the use of the turning plow. This is the case where weeds cover crops, or the remains of the preceding season's pea vines remain. To secure the greatest benefits in the conservation of moisture the plowing should begin as early in the spring as the soil becomes sufficiently dry to work. It is a mistake to wait for winter cover crops to run up. The sacrifice is greater than the gain.

THINNING THE FRUIT.

While the advantages of thinning are recognized by all, neglect of thinning fruit is more usual than the opposite. Some effective thinning is done at the time of pruning the tree each spring, but this is not sufficient. The best practice requires that the peaches on a limb shall not be closer than four to six inches. This will mean knocking off from half to three-fourths of the peaches. Some who practice thinning reduce the number of peaches still more. The best time for thinning is when the peaches are about the size of a small prune, and after what is known as the "June drop." The common hired man makes the cost of thinning of a medium tree about five cents a tree or less. The effect on the size of the remaining fruit is astonishing, increasing the salable value of the remaining fruit sufficient to pay 1,000 per cent on the cost of the work of thinning, to say nothing of the great saving to the strength of the tree in reducing the number of pits borne.

GATHERING THE CROP.

Peaches are gathered as soon as ripe, not before. An experienced picker can tell at a glance when the fruit is in the proper condition. The greenness on the lighter side has barely disappeared. The fruit should never be pressed with the thumb point to determine its ripeness. When gathered the fruit is taken direct to the packing shed where it is graded and packed at once into the carriers. The most rigid standards should characterize the assorting and packing of grades. A misshapen, soft or undersized specimen may spoil the entire package. Any deception, either intentional or otherwise, in the business of selling the crop, is sure at last to bring loss. The most popular and satisfactory package is the six basket carrier, holding about $^3/_5$ of a bushel. Each package should be subjected to inspection by an expert when packed. It is then "topped" and stamped or labeled with the brands on the ends. Some of the larger orchards have side tracks running convenient to their orchards. These and packing sheds are built by the railroad companies when there are sufficient quantities to be shipped. At Smelzer's Fruit Farm, Van Buren, the Frisco has supplied a side track sufficient for ten cars, and a packing shed 30x160 feet for his convenience and that of other large shippers. During the shipping season the Wells-Fargo Express Company maintains an office there for the handling of local shipments. Express shipments are sent out behind regular passenger trains, or sometimes by a special express train. The large shipments are loaded on iced refrigerator cars which are provided by the railroads on a few hours' notice. In distant shipments these are re-iced at one or more points. One hundred and twelve cars, containing 875 crates each, have been shipped from the point above named in some seasons, the growers receiving from $1.00 to $1.45 a crate, making gross receipts $330.00 and net $230.00 an acre.

THE OUTLOOK.

During the past few years peach plantings in the south have increased so rapidly that some fear overproduction and collapse. Georgia plantings, it is reported, have more than doubled in the past four or five years. Extensive plantings are increasing in other southern regions, notably in Texas. The great increase in peach growing in Arkansas was mentioned early in this bulletin. But the consumption of fruit is increasing, in general and per capita, with extension and improvement in the methods of distribution, with improvement in the quality of the market supply and the methods of production, with the rapid increase of population, and with the opening up of new markets. It will be remembered also that all trees planted do not make successful orchard trees. In fact very many fail earlier or later, so that the actual increase in orchard production is less than the apparent. Although the actual increase is still great, overproduction is only a relative term. There has never yet been actual overproduction of good fruit except locally. There is easily such a thing as overproduction of poor fruit,—indeed there has always been and likely always will be. Actual overproduction means the production of good fruit in such quantities that all the population is supplied at a fair price with more fruit than it can use during the year, or while the supply lasts or can be made to last. Has this ever yet occurred? Uusually when the large markets are overstocked and the "bottom has dropped out of prices," in most of the smaller towns the same fruit cannot be had in the market at any price. As the term overproduction is commonly used it really means (1) local surplus, (2) inferior fruit.

The remedy is self-evident. It is obvious that as production increases growers must give more and more attention to the production of fruit of a better grade. This will mean the limitation of plantings to such sizes as can be given good care,—plantings in locations best suited the production of high quality in the fruit grown, and practice of the best and most economical efficient methods, including thorough preparation of land, pruning, cultivation, the intelligent use of fertilizers and means for controlling insects and fungi. In short, *as commercial fruit growing advances the fruit grower himself must advance.* The conditions call for the exercise of more and more intelligence—in other words, education,—especially education in the sciences that relate to the management of soil and plants with the aim of producing the best results at the least cost, and disposing of the products to the best advantage.

In its best development fruit growing, as well as horticulture, in general is (1) a science (as to the principles involved), (2) an art as to the application of these principles in the practice of growing crops, and (3) a business in the selling of the products to the best advantage.

A local surplus ordinarily means in reality lack of business method and foresight. It is a matter of distribution, or rather inadequate distribution; i. e., failure in getting the crop to the points, even remote, where a supply is wanted. Good distribution represents the business side of fruit growing, and includes: rapid transportation, adequate transportation, refrigerator car service, cheap ice for refrigerator purposes, extending the market season by means of varieties which ripen at different times—especially in the case of summer fruits and perishable fruits, extending the market season (in the case of some fruits) by cold storage; development of new markets, careful grading, attractive and careful packing,—the use of small and fancy packages, gathering at the proper stage, systematic, quick and careful work in harvesting, utilization of fruits in different forms, or other than the fresh, thorough drying, canning, preserving, the manufacture of jellies, syrups, etc.,—and lastly, local organization in fruit interests, to keep in touch with markets, market conditions, similar interests in other places, and to encourage better methods.

It is probable that in spite of all this occasionally fruit will be abundant in all sections of the country and prices low. Ordinarily, however, frosts and freezes, especially at the north, have a disastrous effect except in the most favored places. Nevertheless as the commercial fruit industry grows obviously it will be necessary to give increased attention to all the matters above mentioned. In other words, the fruit grower should be a better fruit grower, a better business man. Then the problem of overproduction may be left to the man who produces the poorest fruit in the biggest quantities.

COWPEA HAY.

By C. L. Newman.

Cowpea as a feed for all hay-eating animals has not been fully appreciated. It is very much superior to timothy and other hays made from the true grasses, the difference in favor of first quality cowpea hay not infrequently being double the feeding value of the ordinary grass hays usually found on the market. As compared with alfalfa and red clover hays cowpea hay is superior in composition and at least equal in digestibility. A ton of cowpea hay is equal in feeding value to a ton of wheat bran, the proportions and quantities of digestible food elements being practically the same in the two feeds, yet on the local market cowpea hay sells for from $12.00 to $14.00 per ton and wheat bran from $18.00 to $20.00 per ton. An equal quantity of the two feeds will produce practically the same amount of milk, energy or growth.

Prof. Hopkins reports (Bul. No. 43, Ill. E. S.) digestion experiments with cowpea ensilage, fed to high grade Shorthorn steers, in which the cowpea ensilage gave better results than clover hay. He states that when "both composition and digestibility are considered, it is shown that 100 pounds of dry matter of cowpea ensilage furnishes 8 pounds of protein and 1,300 colonies of energy above that furnished by 100 pounds of dry matter in clover hay." and "the digestibility of cowpea ensilage is so much greater that it furnishes an equal amount of fat and much more protein and total energy than the clover hay." Cowpea hay has so high a content of protein that it should be fed with some coarse forage, such as millet, corn, sorghum, teosinte, other coarse grasses and the like, that its full feed value may be secured. If fed alone the animal cannot utilize all the protein of the cowpea hay and a portion of the most valuable ingredient of the feed is wasted. On the other hand work animals fed an abundance of cowpea hay require but little grain in winter and none in summer. For young and growing animals and for milk cattle cowpea hay fed alone is not only equal but superior to wheat bran, and from 25 per cent to 50 per cent cheaper.

The cowpea plant is of such easy growth throughout the South that a better understanding of its merits as a hay and grain producer and as a soil improver should encourage farmers not only to increase the numbers of live stock kept on the farm, but to also grow all the feed necessary for their sustenance.

Large quantities of hay that should be grown at home are shipped into Arkansas. The bulk of this hay comes from the Indian Territory, Oklahoma and Texas, and is known as ''prairie hay.'' It costs less per ton than any other hay and not infrequently is but little better than straw, being composed of native grasses and weeds cut when the largest quantity may be secured and with little or no regard as to quality. The abundance and cheapness of the prairie hay has had anything but a stimulating effect upon the production of hay in the State. Within the past few years, however, there has been quite a reduction in the area devoted to the production of this hay by opening to settlement and putting in cultivation large areas of hitherto unoccupied land.

The intelligent production of hay is a profitable industry in many localities of the state. According to the U. S. Census report the average hay yield of the United States for the past ten years has been 1.32 tons per acre, and for Arkansas the same report gives a ten years' average of 1.35 tons per acre, of .03 above the average for the whole country. Exclusive of peas and hulls cowpea hay grown on the station grounds the past five years has ranged from .37 of a ton to 4 tons per acre, the average of all plots of all varieties being 1.58 tons per acre. The above refers to cowpeas grown principally for experimental purposes. On larger areas and where the hay was grown primarily for feed and from varieties well suited to the production of hay, the average yield has been well above two tons per acre, not including peas or hulls, and when the peas were harvested with the vines the average has been approximately three tons per acre.

In 1902 and again in 1903, more than 300 plots of cowpeas were grown and harvested under field conditions. In 1902 the yield of hay from 141 plots was recorded and from 153 plots in 1903. Of these 294 plots only eleven gave less than 1,000 pounds of hay per acre (exclusive of peas), 87 plots gave between one and two thousand pounds per acre, 108 gave between two and four thousand pounds per acre and 88 plots more than four thousand pounds. The average yields of cowpea hay for the past five years as computed from all plots of all varieties of which a record was made, are as follows:

1899	3,183 lbs. hay per acre.
1900	2,773 lbs. hay per acre.
1901	3,369 lbs. hay per acre.
1902	3,609 lbs. hay per acre.
1903	2,913 lbs. hay per acre.
Five years' average	3,169.4 lbs. hay per acre.

With the exception of a very few cases these averages do not include the weight of either peas or hulls. When the pods were harvested with the hay the yield of peas was light. Usually the harvesting of the hay was delayed until the peas could be gathered. In many cases this necessarily reduced the yield of hay, many leaves having fallen from a number of varieties before all the peas were sufficiently ripe to be gathered.

In 1902, sixteen plots produced more than 6,000 pounds of hay per acre, eight of which ripened no peas, or so small a quantity that they were not worth the gathering. The highest acreage yield recorded in 1902 was 8,750 pounds made by the variety Clay. This 8,750 pounds of hay bore only 2.9 bushels of shelled peas. The lowest yield of hay was 750 pounds per acre produced by one plot each of New Era and Extra Early Black Eye. These two plots yielded respectively 1,337.5 and 1,025 pounds of shelled peas per acre. The weight of the peas and hulls produced by these two varieties in this instance was double the weight of the cured vines that bore the peas and hulls. One plot of Wonderful (or unknown) yielded 8,350 pounds of hay per acre and no blossoms had appeared upon the vines when harvested in October. Two other plots of this variety ripened no peas. Two plots of Clay produced 8,250 and 7,450 pounds of hay per acre and no peas worth gathering.

These great varietal differences have an important bearing upon the selection of varieties to be grown for whatever purpose, and particularly when the prime object of their culture is the production of hay. Lack of recognition of these differences in the habits of varieties is a fruitful source of failure, or of at least unsatisfactory results and of disappointment. On the other hand, a due consideration of these varietal variations will enable the grower to select varieties well suited to each of the various purposes for which the cowpea is grown.

Since the summer of 1898 more than 550 plots of cowpea vines have been cut for hay, including about 50 varieties. A number of these varieties, and particularly those of dissimilar characters, were grown in multiple plots, cut at various degrees of maturity and under a variety of weather conditions. The results of attempts to cure these various lots of hay range from perfect success to complete failure. A review of the results of these tests extending through five years seems to warrant these conclusions:

(*a*) Cowpeas of any variety harvested while young or in vigorous growth are difficult to cure into hay no matter how favorable the weather conditions.

(*b*) Mature vines are cured with little difficulty in favorable weather, and usually cure in fair to excellent condition after an exposure of two to four days of rain and cloudy weather.

(*c*) Varieties producing the heaviest yield of peas are most easily cured into hay, while those producing a few peas, or none at all, were the most difficult to cure, since they habitually continue in vigorous growth until checked by frost.

(*d*) Late, shallow cultivation prolongs the period of growth and makes the vines more difficult to cure. Cultivation should cease when the first pods appear if the crop is intended for hay.

(*e*) Vines bearing a fair or full crop of peas that ripen well together are easily cured when one-fourth or more of the peas are thoroughly ripe and no second growth of vine has been induced by excessive moisture.

(*f*) Vines bearing a fair or full crop of peas ripening through a prolonged period through which the plants continue in vigorous growth are usually difficult to cure in other than the most favorable weather.

The numerous varieties of cowpeas differ so widely in various respects that their peculiarities must be considered when the crop is grown for hay and the time of mowing, treatment while in the swathe. in wind-rows and in cocks adjusted not only to the condition of the weather, but also the peculiarities of the variety, and to variations due to climate and soil.

The cowpea plant is very amenable to environment, and while there are constant varietal characteristics the yields of both grain and hay are remarkably variable with the same variety grown from seed which come from unlike or widely separate localities, and sown upon soil selected for its uniformity. Examples of the variations as affecting the yield of hay are given below:

Whip-poor-will, seed from Ark., yielded..1,300 lbs. per acre.
Whip-poor-will, seed from Fla., yielded..1,900 lbs. per acre.
Whip-poor-will, seed from Ky., yielded...1,900 lbs. per acre.
Whip-poor-will, seed from La., yielded...2,200 lbs. per acre.
Clay, seed from Va., yielded............3,800 lbs. per acre.
Clay, seed from Ga., yielded............4,200 lbs. per acre.
Clay, seed from Fla., yielded............4,600 lbs. per acre.
Clay, seed from S. C., yielded...........5,000 lbs. per acre.
Clay, seed from La., yielded............8,300 lbs. per acre.
Clay, seed from Ark., yielded............8,700 lbs. per acre.
Wonderful, seed from N. C., yielded......3,300 lbs. per acre.
Wonderful, seed from Tenn., yielded.....4,000 lbs. per acre.
Wonderful, seed from S. C., yielded.....5,400 lbs. per acre.
Wonderful, seed from Fla., yielded......7,000 lbs. per acre.
Black, seed from Ark., yielded..........2,400 lbs. per acre.
Black, seed from Ga., yielded............5,700 lbs. per acre.
Red Ripper, seed from Ala., yielded......2,300 lbs. per acre.
Red Ripper, seed from Fla., yielded......2,600 lbs. per acre.
Red Ripper, seed from La., yielded.......3,500 lbs. per acre.
Red Ripper, seed from Ark., yielded......4,300 lbs. per acre.
Red Ripper, seed from Tenn., yielded.....4,600 lbs. per acre.
New Era, seed from Md., yielded........ 700 lbs. per acre.
New Era, seed from Ark., yielded........1,900 lbs. per acre.
Black Eye, seed from Okla., yielded..... 700 lbs. per acre.
Black Eye, seed from Ind., yielded...... 800 lbs. per acre.
Black Eye, seed from S. C., yielded......1,600 lbs. per acre.
Black Eye, seed from La., yielded........3,500 lbs. per acre.
Black Eye, seed from N. C., yielded......4,000 lbs. per acre.

These great variations in the quantities of hay produced on different plots of the same variety could not have been affected by local conditions to more than a very slight extent, since the several lots of each variety were not only grown upon soil of uniform fertility, but were given the same treatment in every respect from preparation of soil and planting through harvesting and curing. The plot of Clay peas that produced 3,800 pounds of hay from Virginia grown seed was alongside the plot that produced 8,700 pounds of hay from Arkansas grown seed. Black Eye from Indiana was adjacent to Black Eye from

North Carolina—one producing 800 pounds and the other 4,000 pounds of hay per acre. New Era from Maryland produced 700 pounds while home grown seed gave 1,900 pounds of hay per acre. On the other hand, the Maryland seed yielded 22 bushels of peas against 19 bushels from the Arkansas seed.

The wide variation in the yields of both hay and peas from seed of the same variety procured from different sources is probably due, in part at least, to the greater or less adaptability of the soil or climate, or both, where the tests were made, as compared with the soil and climate where the seed were grown. Another cause for the variation may be due to the development of strains of the different varieties from their having been grown in certain localities for a number of years. Seed of Clay cowpeas from Virginia produced 3,800 pounds of hay and 3.7 bushels of peas per acre on the station grounds. Adjacent to this plot was another of the same variety, the seed of which had for five consecutive years been grown on the station grounds at Fayetteville. This plot produced 8,700 pounds of hay and 2.1 bushels of peas per acre. These two plots were planted the same day, the same quantity of seed sown on each plot, and the harvesting was done on the same day. The vines from Virginia seed had ceased to grow when harvested and were in three days cured into passably good hay, while the vines from home grown seed were, when harvested, in as vigorous growth as at any previous time, and required ten days of favorable weather for curing into inferior and partly mouldy hay.

Other marked variations in the yield of hay are reported on page 31, Ark. Ex. Sta. Bul. No. 77, plots Nos. 95-98, inclusive. Seed of the variety Black Eye procured from Oklahoma, Indiana, South Carolina and North Carolina produced respectively 700, 800, 1,600 and 4,000 pounds of hay per acre, and 17, 18, 15 and 11 bushels of peas per acre. The first two (from Oklahoma and Indiana) ripened their peas first of 123 plots, the third (from S. C.) ripened medium early, while the fourth (from N. C.) ripened thirty-four days later than the first two. The hay from the first three plots was cured in perfect condition, save for the loss of a large proportion of the leaves, and the fourth cured in fair condition and produced 900 pounds of hay more than the other three plots combined.

Whip-poor-will seed from Southwest Georgia produced 2,500 pounds of hay and 8.5 bushels of peas per acre, and seed of the same variety from the west-central part of the same state produced 1,700 pounds of hay and 22.2 bushels of peas per acre. Two plots of

Wonderful from different localities in Georgia produced 4,000 and 8,300 pounds of hay. Neither of these ripened any seed, and the vines were in vigorous growth when harvested in October. The hay cured in such bad condition that it was not housed, while some two dozen plots of other varieties cut the same day cured into excellent hay. These peas, however, were mature and making no growth when harvested. Had the Wonderful produced a good crop of peas it is probable that the vines would have cured into at least fair hay, since the energy of the plant expended in producing and ripening fruit would have had a maturing and ripening effect upon the vines.

To observe the effects of maturing upon the curing of cowpea hay from vines mown at different stages of growth, four mowings each of five varieties were made. The seasons of the varieties selected were very early, early, medium, late, and very late. The first mowing from each variety was made when that variety had formed its first pods; the second mowing was made when each variety had ripened its first pods; the third when half the pods were ripe, and the fourth when all the pods were ripe. The names of the five varieties used in the test follow with the dates of ripening of the first pods of each variety:

Warren's New Hybrid, August 15.
Warren's Extra Early, August 20.
Whip-poor-will, August 28.
Taylor, September 8.
Clay, September 14.

The first mowings made when the first pods were forming occurred on a different date for each variety, the vines of the first three varieties curing into indifferent, mouldy and slightly rotten hay, while the latest two, Clay and Taylor, rotted before the vines could become hay. The *second* mowing of Warren's New Hybrid was made on the same day as the *first* mowing from Taylor, and the *second* of Warren's Extra Early was made on the same day as the *first* from Clay. The two Warrens with their first pods ripening, cured into very fair hay, but Taylor and Clay upon which the first pods were forming, rotted and moulded. The first mowing from Taylor and the first and second from Clay were failures, as far as the curing of vines into hay is concerned. The third mowing from Clay was but little better than the second, while the fourth mowing developed only indifferent hay. The two later mowings from Taylor were very good. All of these varieties fruited heavily except Clay, which bore less than one-sixth of a crop as compared with the yields of the others, and was still growing and blossoming when the fourth and last mowing was made in anticipation of frost. These five varieties were sown on June 9th and upon soil from which a very heavy growth of rye and vetch had just been harvested. The number of days from date of sowing to date of the appearance of first ripe pods for each of the varieties in the above test is given below:

Warren's New Hybrid, 67 days.
Warren's Extra Early, 72 days.
Whip-poor-will, 80 days.
Taylor, 90 days.
Clay, 97 days.

While there was only seven days difference between the appearance of the first ripe pods from Taylor and Clay, the actual difference in approach to maturity was very much greater, since Taylor ripens in much shorter time after the appearance of the first ripe pods than does Clay, the former usually having no blossoms when the first pods ripen, while Clay continues to blossom and grow vigorously long after the first pods ripen.

On July 8th, 1903, one plot each of twelve varieties was planted in the same field and near plots of the same twelve varieties planted May 13th. These varieties were:

Black Eye,
Lady,
Brown Crowder,
Large Black Eye,
Brown Eye,
New Era,
California Black Eye,
Conch,
Red Ripper,
Clay Crowder,
Warren's Extra Early,
Whip-poor-will.

These were all mown at the same time and three of them, New Era, Black Eye and Warren's Extra Early had ripened a full crop of peas, and the vines were, at the end of two days, well cured into excellent hay ready for the barn. Brown Eye, California Black Eye, Large Black Eye and Whip-poor-will had ripened a fair quantity of pods and the vines cured into very good hay. The remaining five varieties (Brown Crowder, Clay Crowder, Conch, Lady and Red Ripper) were in vigorous growth and with only occasional ripe pods when mown. The vines cured slowly into very inferior hay, all of which was mouldy and portions rotten.

Of the large numbers of plots and of varieties of cowpeas that have been mown for hay on the station grounds since 1898, but few have been successfully converted into hay, when mown while in vigorous growth. On the other hand, quite a number of lots of a number of varieties have been cured in good condition when cut fully ripe and after having lain in the field through several days of rain and little sun.

SOWING COWPEAS FOR HAY.

The subjects of preparation, planting and cultivation of cowpeas are discussed on pp. 5-10, inclusive, Bull. 77 of this station, but probably more from the standpoint of grain than hay production. In quite a number of experiments conducted on the station grounds the effects of the fertilizing value of cowpea stubble have been compared with the fertilizing value of the whole plant plowed in (Ark. Agric. Expt. Sta. Buls. Nos. 62, 66, 70 and 77) and the conclusion reached was that "The most profitable use to be made of the cowpea plant is to feed it to live stock." The soil and climate of Arkansas are so well adapted to the cowpea plant and profitable returns so easily obtained that it is too often the case that primitive and shiftless methods are employed in the culture of this crop. Such thorough preparation of the soil as has been practiced for wheat (Ark. Ex. Sta. Bul. No. 62, p. 19) and for oats (Ark. Ex. Sta. Bul. 66, p. 9) has invariably given increased yields of both cowpea grain and hay, ranging from 25 per cent to more than 100 per cent.

The very general custom of sowing broadcast is usually not only wasteful of seed, but almost invariably gives a diminished yield of both hay and peas, as compared to drilling; the increase from the latter method being due in large measure to the cultivation permitted by the drills. The ordinary bean and corn planters and grain drills, the latter with every second or third tube plugged, are very satisfactory implements for drilling cowpeas.

The quantity of seed to be sown is a matter of much greater consequence than is generally supposed. The seedsman's catalogues recommends not less than one bushel of seed per acre and some as high as three bushels, and without regard to the variety to be sown. The individual peas of such varieties as Conch and New Era are small and 226,000 of one and 238,000 of the other are required to make one bushel; on the other hand one bushel of Extra Early Black Eye and Taylor contain 80,000 and 81,000. Thus one-third of a bushel of Conch or New Era contain practically the same number of peas as one bushel of Extra Early Black Eye or Taylor. It does not follow, however, that equal numbers of seeds of different varieties sown to a given area will give like returns, since the habits of the various varieties is another important matter for consideration. This is illustrated by comparing Conch and New Era. The latter is of bunch habit while the former is decidedly vining and has produced from 12.5 pounds of seed per acre more hay than New Era produced from 25 pounds of seed sown upon an equal area. The New Era, however, is superior to the Conch for hay production on account of its upright growth, heavy fruiting and uniformity in maturing. The Conch has long, prostrate vines and a prolonged period of growth.

In 1900, a series of plots was sown in quantities of Whip-poor-will peas ranging from 15 pounds to 120 pounds per acre. The smallest quantity of seed produced the heaviest yields of both hay and peas. In 1901 the test was repeated, the quantities of seed per acre ranging from 12.5 lbs. per acre to 100 pounds. Again the smallest quantity of seed sown gave the heaviest yields of both hay and peas. In 1902 and 1903 the range was from 6.25 lbs. per acre to 100 lbs.

The yields per acre of the hay produced from the various quantities of seed in the four years' trials are given in the following table, together with the averages of the yields of the plots upon which like quantities of seed were sown:

Weight of Seed Sown per Acre, Pounds.	NO. POUNDS OF HAY PER ACRE				Average Yield of Hay for 1901 '02 & '03.
	1900	1901	1902	1903	
6.25	....	....	3700	4125	3912
12.50	....	2675	5500	5445	4540
15.00	3315	....	....	....	....
25.00	....	1825	4920	6510	4418
30.00	3287	....	....	....	....
37.50	....	2550	4140	6125	4272
45.00	2641	....	....	....	....
50.00	....	2187	4580	5065	3944
60.00	2463	....	....	....	....
75.00	....	1733	4080	5420	3744
90.00	2111	....	....	....	....
100.00	....	2275	3500	5305	3693
120.00	1749	....	....	....	....

The Whip-poor-will was used throughout this test because of its being more widely grown than any other variety. The quantities of seed producing the heaviest yields of hay was in no case below 12.5 pounds per acre nor above 25 pounds. The average was about 16 pounds per acre.

The habit of growth of the numerous varieties of cowpeas is so variable it was thought probable the results obtained from a test made with Whip-poor-will would not apply to other varieties. In 1903 seven plots each of six varieties were sown to quantities of seed varying from 6.25 pounds to 100 pounds per acre. The soil upon which this test was made was above the average in fertility, having been well fertilized the previous year for Irish potatoes. The results are given in the following table:

POUNDS OF SEED SOWN. lbs. per acre.	RED PEPPER. Hay, lbs. per acre.	WARREN'S EXTRA EARLY. Hay, lbs. per acre.	WARREN'S NEW HYBRID. Hay, lbs. per acre.	WHIP-POOR-WILL. Hay, lbs. per acre.	TAYLOR. Hay, lbs. per acre.	CLAY. Hay, lbs. per acre.	AVERAGE FROM LIKE QUANTITIES OF SEED. Hay, lbs. per acre.
6.25	6300	2400	1150	4100	3000	3300	3375
12.50	7550	3500	1850	5400	3025	5800	4521
25.00	7000	5400	2800	6500	3700	5600	5166
37.50	6250	4800	1950	6100	3950	6000	4841
50.00	4450	3400	2400	5000	4100	6200	4258
75.00	4100	2800	2800	5400	4050	5900	4175
100.00	4500	3200	2200	5300	4300	5050	4091
Averages....	5593	3643	2164	5400	3732	5407	

The highest average yield was produced from 25 pounds of seed. The heaviest yield of hay from Whip-poor-will was from 12.5 pounds of seed per acre and 100 pounds of Taylor yielded the best returns, though only 350 pounds more than was secured from 37.5 pounds of seed. The individual peas of Taylor are larger and heavier than the other varieties used in the test. Warren's New Hybrid gave the highest yields of hay from 25 and from 75 pounds of seed per acre. While the individual peas of this variety are smaller than any variety used in this test, the vines are of a more decided bunch habit than any other variety grown on the station grounds, with the probable exception of Old Mans. The quantity of seed that produced the heaviest yield of hay does not necessarily produce the heaviest yield of shelled peas. This was illustrated by a test made with the same varieties for the purpose of determining what quantity of seed sown would produce the heaviest yield of shelled peas, and in no case did more than 37.5 pounds give the best results, which were secured from not less than 12.5 nor more than 37.5 pounds per acre.

HARVESTING AND CURING COWPEA HAY.

On small farms, and particularly when grown between the rows of corn, cowpea hay is not infrequently harvested by pulling the vines by hand and throwing into small cocks between the corn rows where the vines remain until cured. All of the peas may have been gathered by hand, or a part, or none at all gathered. Weeding hoes and scythes are also used for cutting the vines. These are tedious and expensive methods and are not recommended save when no better are practicable. The usual, most practicable and economical method of harvesting is with the mowing machine. Such varieties as Wild Goose, Little Iron, Lady, Jones Prolific and others are, however, of such prostrate growth that it is a difficult undertaking to harvest satisfactorily for hay with mowing machine, or in any way, for that matter. In sowing for hay the habit of growth should not be overlooked, and the employment of varieties of more or less upright growth will greatly facilitate both harvesting and curing. New Era, Whip-poor-will and Wonderful are of decided upright growth and admirably suited to the use of the mowing machine, while a majority of the varieties commonly grown are not difficult to harvest by the same means.

The treatment of cowpea vines from the time they are cut until the cured hay is stored, depends upon several things that are worthy of consideration. If the vines are ripe for hay; *i. e.,* have ceased to grow and maturity is indicated by the color of the leaves, the hay will usually be cured sufficiently for storing in 36 or 48 hours of favorable weather conditions. If green and in vigorous growth when mown, they may not cure at all.

The quantity of vines upon a given area has an important bearing upon the length of time required for curing and upon the quality of the hay when cured. The weather is, of course, an important matter. The greener the vines, the greater the liability for loss from unpropitious weather. On the other hand, vines in prime condition when mown and well cocked after lying a day will endure a week or more of rainy weather with but slight damage, and cure into high grade hay.

The prevailing custom in making cowpea hay does not differ materially from the methods employed with clover, alfalfa and soy beans; and, in good weather is usually successful when the yield is not excessive and the vines are mature.

The vines should be cut in the morning as soon as free from dew and when the indications are for favorable hay-making weather. The length of time the vines should remain in the swathe depends upon the quantity of vine, degree of maturity and the weather. A cloudless day with high temperature, dry air and high wind will induce rapid curing, and with a combination of such conditions hay cut in the morning should usually be wind-rowed or cocked in the afternoon. As soon as the more exposed leaves are well cured, but not dry enough to crumble, the hay should be teddered, or in the absence of a tedder, raked into wind-rows. Having remained in wind-rows until the upper portion is well cured the wind-rows may be rolled over that the under portion may be exposed for a time. The hay is then thrown into cocks where it remains until taken to the barn or stacked. In making the cocks from wind-rows time may be saved by bunching with hay rake and finishing cocks by hand with the fork. If that portion of the cocks near the ground is slow to cure, the cocks may be turned over to the north a few hours before hauling begins that the under portion may be exposed to the sun and curing hastened. On several occasions cocking has been dispensed with when the growth of vine was very heavy and the hay cured by rolling the wind-rows over, alternately exposing portions of the surface to the sun for two or three days, when the hay was loaded from the wind-rows and stacked or stored. Poles, seven to nine feet long, have successfully been employed in curing cowpea hay. The poles are driven into the ground at suitable intervals after the vines are mown. When thoroughly wilted the hay is raked into wind-rows or bunched near the poles and stacked about them to a thickness of four or five feet and to the top of the pole. The hay remains thus until thoroughly cured. Another successful method is to stack the green but wilted vines about poles 12 to 16 feet high. Stout poles are firmly planted in the ground and two cross pieces nailed to the post at right angles to each other and about a foot from the ground. The wilted vines are then stacked three or four feet deep about the poles, and over the two cross pieces. Two more cross pieces are then nailed to the post at right angles to each other and three or four feet above the first two cross pieces. Upon these more vines are placed and other cross pieces nailed above, and so on to the top of the pole, when the stack is drawn to a point and capped. Hay of exceptionally good quality has been cured by this method from vines stacked as mown.

Hollow or triangular stacks have been employed in curing the vines when stacked green or merely wilted. Three poles are nailed so that their upper ends are from 12 to 20 inches and the lower from four to five feet apart. Rails, poles or brush are arranged around the base of the stack upon which the vines are placed to the top of the frame, and so capped as to admit of free circulation of air through the center of the stack. These stacks may be 8 to 12 feet in diameter, and have been successfully employed in curing pea hay stacked the day it was mown, but well wilted. Another excellent and practicable method has been previously published in bulletins Nos. 27 and 61, to which the reader is referred.

FERTILIZERS.

By A. M. Muckenfuss.

INTRODUCTORY.

Through the courtesy of the Director of the Station, this bulletin is prepared for the information of Arkansas farmers. It does not aim to treat in detail the subject of fertilizers, but simply to furnish the analytical results for the season and discuss them in an elementary manner. This station has already published a bulletin (No. 19) upon the subject of manures, which treats of the principles of soil fertility.

OBJECT OF FERTILIZER ANALYSIS.

It is very difficult to the farmer, or any one else, to tell a good fertilizer from a poor one, except by chemical analysis or by actual test in the soil. In former times, before the days of inspection, many frauds were perpetrated. A half-year must pass, and sometimes another year, before the unsuspecting purchaser finds that he has been grossly defrauded. Before a manufacturer can sell his product, he must guarantee its composition. The object of the chemical analysis is to ascertain whether the actual composition shows a lower value than the one guaranteed. In the latter event the law provides a penalty.

RETROSPECT.

The use of fertilizers is as old as civilization itself. Doubtless, they came into requisition for the same cause that now holds, the "necessity" of soil exhaustion was the mother of the invention. It was not very long ago, and is still true on many farms, that waste matter was placed where least inconvenient, not where most useful. This is still the "great American principle" of sewage disposal. Before the war between the States, many of the Southern commonwealths had stringent laws concerning the disposal of their great nuisance, cotton seed. These were not to be left near dwellings or running streams. As a consequence of a reckless method of agriculture, seventy-five years has easily sufficed to exhaust fertility.

CONSUMPTION OF COMMERCIAL FERTILIZERS.

Georgia is the largest user of the South[1] and Arkansas the smallest. The South Central States, including Arkansas, showed an increase in consumption in 1890 over 1880 of 143.1 per cent,[2] but in 1900 this rate of increase was reduced to 35 per cent, showing a more economical use of fertilizers.

SOUTHERN STATES COMPARED.

It will be interesting to append here the tonnage used in 1901 in a few near-by or prominent Southern States,[3] in comparison with Arkansas for the past season.

Mississippi	65,000
Louisiana	48,000
Tennessee	40,000
Georgia	478,000
Arkansas	8,027

SALE OF FERTILIZERS IN ARKANSAS, 1903.

Manufacturers who registered for 1903 were asked by the professor of chemistry in the State University at the close of the year to report the number of tons sold, in what portions of the state, and at what seasons of the year. All except one small company have reported, though very few made statements as to time of year material was sold. The information is tabulated below in the form received.

	Tons.
State at large	1,401.55
Southern Arkansas	6,163.2
Eastern Arkansas	237.
Northwestern Arkansas	225.
Total tonnage reported	8,026.75

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[1] Bull. 13, U. S. Dept. Agr.
[2] Twelfth Census, vol. 5. Pt. 1, p. 236.
[3] Bull. Tex. Exp. Sta., No. 67.

January 1 to June 15	2,238.
June 16 to November 30	61.
December 1 to December 31	61.
	2,360.

It cannot be stated that the first table approximates the truth. The census report for 1900 as to value of fertilizers used in the state in that year, given in the next paragraph, would indicate a larger tonnage.

There is no intention to question the integrity of manufacturers, but there may have been brands on sale in 1903 that were never registered. One of the objects in publishing this bulletin is to prevent any such occurrence in 1904, and farmers are urged to report to the professor of chemistry of the State University any brands on sale during this year that are not listed in these pages.

DEVELOPMENT IN ARKANSAS.

In 1897 up to Oct. 1, 1000 tons of fertilizer were purchased in this state.[4] Referring to the various Census reports, it is found that the value of fertilizers purchased in three decades shows a notable increase, though always meagre in comparison with other states.

1880	1890	1900
$56,314	$93,939	$172,510

CLASSES OF FERTILIZERS.

Two classifications are given below, depending on the point of view.

	Available Phosphoric Acid.	*Nitrogen.*	*Potash.*
High Grade	8 per cent.	4 per cent.	7 per cent.
Low Grade	7 per cent.	1 per cent.	2 per cent.

These are only approximate. According to the Mississippi Experiment Station (Bull. 82), the average for a "standard brand" is 8 per cent "soluble" and 2 per cent "reverted" phosphoric acid, 2 per cent nitrogen, and 2 per cent potash.

1. *Complete Fertilizers,* containing all three of the main plant food elements, in proportions suitable to the average conditions.

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[4] Bull. 13, U. S. Dept. Agr.

2. *Fertilizers for Special Crops,* generally so indicated in the brand name.

3. *Fertilizers for Home Mixtures.* This leads naturally to the constituents of fertilizers; for home mixing is simply manufacturing on a small scale.

INGREDIENTS OF FERTILIZERS.

These may be classed as:

1. *Available*
    - Water soluble phosphoric acid.
    - Citrate soluble phosphoric acid.
    - Organic and inorganic nitrogen.
    - Organic and inorganic potash.
2. *Available Remotely.*
    - Nitrogen in leather hair, and hoofs.
3. *Not Available.*
    - Sand.
    - Clay.
    - Undissolved rock phosphate.

SOURCES OF FERTILIZERS.[5]

Phosphoric Acid.

Bones of the slaughter houses.
Phosphate rock of Tenn., S. C., Fla., Ark.
Slag from phosphatic iron ore.

Potash.

Ashes of plants.
Salts from Stassfurt, Prussia (Kainit, muriate and sulphate of potash, carnallite, sylvanite.)

Nitrogen.

Decomposing organic matter in general.
Cotton seed meal and hulls.
Fish pomace and scrap, dried blood, blood and bone tankage, meat tankage, sewage tankage, dried meat, wool waste, woolen rags, leather, horn and hoof meal, hair, skim milk, curds.

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[5] 12th Census, vol. 5, part 1, page 238.

Hoofs, horn, and hair, though quite rich in nitrogen, are almost worthless as fertilizers on account of the extreme slowness with which they decompose. They are nevertheless used sometimes and their presence should be considered fraudulent, since by ordinary analytical processes they simulate high value.

HOW TO USE FERTILIZERS.

This is a question for the practical agriculturalist. No man can name the best fertilizer. Mixtures are made for specific crops, adapted to specific soils and climates, and out of various materials depending on the cost at the locality concerned. Thus in the South we use cotton seed meal generally, while in the North and West inorganic and slaughter house sources are more largely used for nitrogen. The so-called ''cheap'' fertilizers should be avoided, because they contain more useless material, for which freight and cost of mixing are nevertheless to be paid. If all farmers bought rationally, cheap stuff could not compete with high grade material, because in the latter the cost of plant food is less.

WASTE OF FERTILIZERS.

But aside from this there must be a great waste of fertilizers in this country. American farmers paid out in this way in the 36 years prior to 1897 over 800 million dollars.[6] In 1900, the expenditure[7] was $54,783,575. Much of this is doubtless applied to badly cultivated lands, where the proper use of the plow and drainage would give the desired results.

THE PREPARATION OF HOME MIXTURES.

Cotton seed meal contains 7 per cent of nitrogen, 3 per cent phosphoric acid, and 2 per cent potash. It is evident that this yearly Thanksgiving gift presented to the South is lacking in the two latter ingredients to make an ideal fertilizer. Fortunately for this section, nature has provided immense storehouses of rock phosphate, while potash salts may be directly imported from Germany. Knowing that acid phosphate ordinarily contains about 14 per cent phosphoric acid and kainit about 12 per cent potash, it is easy to calculate the amount of each ingredient to use to make a ton of fertilizer of any composition desired, up to a certain concentration.

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[6] Roberts' Fertility of the Land.
[7] 12th Census, vol. 5.

710 lbs. cotton seed meal.	Yield Mixture containing about,	2.5 per cent nitrogen.
1130 lbs. acid phosphate.		9 per cent phosphoric acid.
160 lbs. kainit.		1 per cent potash.
710 lbs. cotton seed meal.	Yield Mixture containing about,	2.5 per cent nitrogen.
990 lbs. acid phosphate.		8 per cent phosphoric acid.
300 lbs. kainit.		1.8 per cent potash.

By using muriate of potash, with strength of 50 per cent instead of 12, a more highly concentrated mixture may be obtained. The above is given merely to illustrate the method of calculation, not to recommend any particular formulas or raw materials.

MANUFACTURED BRANDS VS. HOME MIXTURES.

The mixing of raw materials to produce fertilizers for various purposes is a legitimate business, obeying the law of supply and demand. It will continue to flourish in the future as in the past. Yet it is safe to say that, other things being equal, it will pay to mix one's own fertilizers, or at least for several to club together. Farmers in the state should encourage the registry of raw materials by making a demand for them. There are 19 of these registered for 1904 as against 5 for 1903.

MIXTURES FOR VARIOUS CROPS.

As a suggestion for the preparation of mixtures, the following table is appended:[8]

	Per cent		
	Nitrogen.	*Potash.*	*Phosphoric Acid.*
Tomatoes	4	6	7
Irish potatoes	4	6	7
Onions	4	7	7
Melons	4	7	8
Cabbages	4	7	8
Beets	4	7	8
Strawberries	4	7	8
Sweet potatoes	1	7	7
Beans	1	7	7
Corn	3	6	7
Cotton	3	4	9
Oats	3	4	9
Cucumbers	4	7	8

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[8] Bull. Tex. Exp. Sta., No. 67, page 24.

IS THE USE OF FERTILIZERS PROFITABLE?

In the year 1898 statistics were gathered[9] from 1,495 cotton planters in five states, and it was found on an average that, among those clearing money, the man who had expended 50 cents per acre in fertilizers cleared $4.02 per acre on his crop, while an expenditure of $5.50 brought a profit of $8.76. In other words, an increased expenditure of $5.00 gave an increased profit of $3.98 over all, including cost of fertilizer. On the other hand, those who lost also lost more heavily, with increased expenditure for fertilizers. But 1,268 cleared money and only 227 lost.

The twelfth Census (1900) reports that during the past decade the amount expended for fertilizers is not commensurate with the increase value of crops in some states. This would argue that the farmer now spends less for plant food, but tills more intelligently and rotates more frequently, yet continuing to raise heavier crops. Further, phosphoric acid and potash have perhaps accumulated in the soil by steady use of fertilizers, there being now in some places need only of nitrogen.

DO FERTILIZERS ACT CHEMICALLY OR PHYSICALLY?

This may seem a trite question, but it is nevertheless a very live one at this writing. Dr. Milton Whitney, Chief of Bureau of Soils, U. S. Dept. of Agriculture, in Bulletin 22, adduces considerable experimental data, to show that the distilled water extracts of all soils, rich and poor, are practically identical in composition. He then advances the following propositions:

1. Climate and the physical characteristics of soils mainly decide the yield of crops.
2. There is no obvious relation between the chemical composition of soils and fertility.
3. Practically all soils have sufficient plant food, maintainable indefinitely.
4. The yield depends upon cultural methods, under good climatic conditions, as is the experience of good farm practice.

Dr. E. W. Hilgard, Agriculturalist of the University of California, in Science, December 11, 1903, ably controverts the above conclusions:

1. That the last clause of 4 is hardly the opinion of American agriculturalists.

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[9] Bull. 13, U. S. Dept. Agr.

2. That the ultimate test of a method of soil analysis is its agreement with agricultural practice. By this test reliance upon the distilled water extracts is seen to be vain.

3. That plants probably get their food from the soil by other means than the water solution in soils, as, by the acid root secretions.

4. That among rich and poor, new and old soils, are found all grades of physical characteristics and climates.

5. That the enormous cumulative evidence of practical experience and experimental science for three-quarters of a century is in favor of the chemical action of fertilizers.

The above is a very brief summary of the controversy and is given here in order that the farmers of Arkansas may read the latest phase of the fertilizer problem. Doubtless the good effects of fertilizers are due as much to the timely supply of plant food as to the quantity supplied. Doubtless a large part of their beneficial influence upon the growing crop may be attributed to their effect upon soil texture. The soil needs weathering agencies, to render plant food in the soil soluble and available. Without these and proper physical condition, no fertilizer can be of value.

IMPROVEMENTS TO FERTILIZER LAW.

The present law is so loosely drawn and withall so unsatisfactory that a few suggestions concerning its improvement may not be out of place. Manufacturers should be required to submit samples and make their affidavits by the first of November, instead of the first of January. This will give time for a bulletin to be gotten out soon enough to assist farmers in purchasing. The affidavit should give in detail the source of each constituent of the fertilizer. A "request for inspection" should be sent to the state chemist, as each shipment is made to some point in the state. The law should provide sufficient revenue to employ an inspector and a chemist, for at least six months in each year.

MEANING OF THE ANALYSIS.

The three most important elements of plant food in the soil are nitrogen, potassium, and phosphorus. The law requires that the first be calculated as ammonia, a compound of nitrogen, but custom hardly justifies this now. Nitrogen occupies four-fifths of the atmosphere, where, however, it is utterly useless to vegetation. It must be fixed, and this can be done in three ways, by leguminous plants, and by electric sparks and the electric furnace. The first method is now very generally utilized. The second and third may come into prominence in the future, when the supply of fixed nitrogen fails to be equal to the demand. There may be seen in operation the experimental plant of the Atmospheric Products Company, Niagara, New York, where nitrate of soda is manufactured. Nitrogen is a volatile element, hence heat or decay results in its more or less complete loss, while potash, and phosphates, remain unaffected.

Potassium is one of the metals and is found in living tissue combined with oxygen. This compound is called potash. There is practically only one source in the world for it, the region around Stassfurt in Germany but the supply is almost unlimited.

Phosphoric acid really means a compound of phosphorus and oxygen. This substance can further combine with water to form the true acid, or with metallic oxides to form phosphates. It is the phosphates of lime that are important to plants. There are three of these, with varying solubilities. The term "soluble" refers to that portion of lime phosphate which dissolves in water and is thus immediately available for fertilization. "Reverted" is that portion which has lost its solubility but will be dissolved by water containing ammonium citrate. This means that it is still available, though not at once. The "insoluble" refers to a phosphate that can be dissolved only by acid, generally the portion unacted upon the process of manufacturing acid phosphate. "Insoluble" does not necessarily mean entirely unavailable. Bone phosphate gradually disintegrates in the soil and exerts its effect. Insoluble material represents that much loss to the manufacturer, who therefore reduces it to the minimum.

Arkansas has the distinction of possessing the only important phosphates beds in the Southwest. Bulletin No. 74 of this Station, gives a full description of these. Only one plant, located near Batesville and now entering upon its second season, is utilizing these deposits, but it is hoped that others will spring up and that lower prices on acid phosphates will thereby result.

COMPARISON OF GUARANTEE WITH ANALYSES.

In the table of analyses subjoined, guaranteed and actual compositions are placed side by side for comparison. It is seen that practically every brand comes up to its guarantee. This is not surprising under our present law. Different parts of any dump of fertilizing material will vary more or less in composition and it is to be expected perhaps that the company will send its best "fair and true average sample." Even if the analyses really represent the actual average, they do not tell how far below guarantee some of the material actually purchased in this state might be. Inspection alone will give this much desired information.

CALCULATED VALUES OF FERTILIZERS.

Percent means pounds per hundred pounds. Hence, if we know the cost of the three ingredients, from quotations on raw material, in the open market, we can calculate the relative value of any brand. The actual cost of the brand per ton may be in excess of the calculated in Arkansas, where freight rates vary so much and are never low. The last column of the table is therefore intended simply as a method of comparison between different brands.

FERTILIZERS REGISTERED IN ARKANSAS FOR YEAR 1904.

Name of Manufacturer, Location, and Brand.	Percentages.						Relative Value Per Ton.
			Phosphoric Acid.				
	Ammonia.	Potash.	Available.	Soluble.	Reverted.	Insoluble.	
N. O. Acid & Fertilizer Co., New Orleans, La.							
Black Diamond Acid Phosphate—							
Found	....	....	12.28	8.89	3.39	1.79	11.94
Guaranteed	....	....	12.0	10.0	2.0	2.0	....
Crescent City Acid Phosphate—							
Found	....	....	14.0	10.38	3.62	1.88	13.63
Guaranteed	....	....	12.0	10.0	2.0	2.0	....
Goldsmith's Improved Mixture—							
Found	2.16	1.49	9.88	9.3	0.58	1.34	18.06
Guaranteed	1.65	1.0	9.0	7.0	2.0	2.0	....
Gold Dust—							
Found	2.24	1.55	9.98	6.61	3.37	1.47	18.16
Guaranteed	1.65	1.0	9.0	7.0	2.0	2.0	....
Pure Gold—							
Found	2.23	1.58	9.98	8.62	1.36	1.23	18.36
Guaranteed	1.65	1.0	9.0	7.0	2.0	2.0	....
Blood, Bone and Potash—							
Found	2.13	1.27	8.79	8.29	0.5	1.31	16.56
Guaranteed	1.65	1.0	9.0	7.0	2.0	2.0	....
Blood, Bone and Beef—							
Found	2.16	1.13	8.77	7.2	1.57	1.58	16.38
Guaranteed	1.65	1.0	9.0	7.0	2.0	2.0	....
Standard Guano & Chemical Manufacturing Co., New Orleans, La.							
Sterne Ammoniated Raw Bone Superphosphate—							
Found	2.31	2.63	13.01	6.93	6.08	1.17	22.49
Guaranteed	2.0	1.5	9.0	4.0	5.0	3.0	....
Acid Phosphate—							
Found	....	....	17.61	11.77	5.84	1.3	17.02
Guaranteed	....	....	12.0	10.0	2.0	3.0	....
Kainit—							
Found	....	12.64	....	....	....	....	12.64
Guaranteed	....	12.0	....	....	....	....	....
Champion Farmers' Choice—							
Found	2.3	1.36	9.4	7.7	1.7	2.1	17.66
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Mississippi Home Guano—							
Found	2.3	1.0	9.4	7.6	1.8	2.1	17.39
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Virginia-Carolina Chemical Co., Memphis, Tenn.							
Scott's Gossypium Phospho—							
Found	2.59	1.95	11.31	9.31	2.0	1.06	21.10
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0	....
Royal High Grade Guano—							
Found	2.34	1.87	11.99	9.55	2.44	2.29	21.05
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0	....

Name of Manufacterer, Location, and Brand.	**Percentages.**						**Relative Value Per Ton.**
			Phosphoric Acid.				
	Ammonia.	**Potash.**	**Available.**	**Soluble.**	**Reverted.**	**Insoluble.**	
Mobile Double Eagle Guano—							
Found	2.93	1.55	10.27	9.1	1.17	1.28	20.54
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0	....
Scott's State Standard Guano—							
Found	2.51	2.25	9.14	8.69	0.45	1.26	18.95
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0	....
Royal Cotton Boll Guano—							
Found	2.92	2.06	10.78	10.66	0.12	2.87	21.68
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0	....
Royal Animal Bone Guano—							
Found	3.08	2.31	11.65	8.11	3.54	2.96	22.98
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Royal Vegetable Fertilizer—							
Found	3.3	4.07	9.29	7.65	1.64	2.9	22.92
Guaranteed	3.0	4.0	8.0	6.0	2.0	4.0	....
Royal Compound—							
Found	....	2.18	12.05	8.0	4.05	0.0	13.82
Guaranteed	....	2.0	10.0	8.0	2.0	3.0	....
Scott's High Grade Acid Phosphate—							
Found	....	....	17.14	14.4	2.74	0.0	16.86
Guaranteed	....	....	14.0	12.0	2.0	3.0	....
Royal Acid Phosphate—							
Found	....	....	16.85	14.4	2.45	0.0	16.60
Guaranteed	....	....	14.0	12.0	2.0	3.0	....
Scott's Gossypium Phospho Special—							
Found	2.72	2.46	10.82	9.55	1.27	0.52	21.48
Guaranteed	2.0	2.0	10.0	8.0	2.0	3.0	....
German Kainit—							
Found	....	12.27	....	....	....	....	12.27
Guaranteed	....	12.0	....	....	....	....	....
Mobile Standard Guano—							
Found	2.8	2.0	11.0	8.0	3.0	3.4	21.23
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0	....
Scott's Ammoniated Bone—							
Found	2.5	1.8	10.58	9.95	0.63	0.42	20.03
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Scott's Meal Formula—							
Found	2.6	1.2	11.07	10.4	0.67	0.93	20.24
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Royal Blood, Bone and Potash—							
Found	2.8	1.6	10.5	10.25	0.25	3.5	20.56
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0	....
Meridian Fertilizer Co., Meridian, Miss.							
Meridian Home Mixture—							
Found	2.7	1.87	11.17	9.55	1.62	0.66	21.19
Guaranteed	1.65	1.5	9.0	8.0	1.0	1.0	....
Meridian Blood and Bone—							
Found	2.0	1.5	10.71	8.75	1.96	1.18	18.41
Guaranteed	1.65	1.5	9.0	8.0	1.0	1.0	....

Name of Manufacturer, Location, and Brand.	Percentages.						Relative Value Per Ton.
			Phosphoric Acid.				
	Ammonia.	Potash.	Available.	Soluble.	Reverted.	Insoluble.	
Meridian Vegetable Grower—							
Found	3.3	7.24	8.74	6.46	2.28	0.7	25.31
Guaranteed	2.0	6.0	6.0	5.0	1.0	1.0	....
Meridian Southern Acid Phosphate—							
Found	....	....	15.09	12.86	2.23	0.46	14.87
Guaranteed	....	....	14.0	12.0	2.0	1.0	....
Arkansas Phosphate Co., Phosphate, Ark.							
White Diamond Ammoniated Bone Superphosphate—							
Found	2.47	2.02	12.05	4.64	7.42	2.26	21.12
Guaranteed	2.0	2.0	9.0	....	....	2.0	....
White Diamond 20th Century Fertilizer—							
Found	2.36	1.37	12.11	5.87	6.24	2.72	20.34
Guaranteed	2.0	1.0	10.0	....	....	2.0	....
White Diamond Kali-Superphosphate—							
Found	....	2.78	14.67	3.36	11.31	1.06	16.32
Guaranteed	....	2.5	12.0	....	....	2.0	....
White Diamond Acid Phosphate—							
Found	....	....	15.61	3.57	12.04	1.23	14.41
Guaranteed	....	....	13.0	....	....	2.0	....
Jackson Fertilizer Co., Jackson, Miss.							
Royal C Brand—							
Found	2.5	1.96	10.6	9.6	1.0	1.2	20.18
Guaranteed	1.65	1.8	9.5	7.5	2.0	1.0	....
Acid Phosphate—							
Found	....	....	18.7	14.5	4.2	1.2	18.28
Guaranteed	....	....	14.0	12.0	2.0	1.0	....
Swift & Company, Kansas City, East St. Louis, Fort Worth, Chicago.							
Superphosphate—							
Found	2.43	1.76	9.43	6.52	2.91	1.27	18.32
Guaranteed	2.0	2.0	8.0	....	....	4.0	....
Champion Vegetable Grower—							
Found	4.3	3.0	10.3	6.6	3.7	1.1	25.42
Guaranteed	4.0	3.0	8.0	....	....	3.0	....
Garden City Phosphate—							
Found	....	....	15.0	11.4	3.6	2.0	14.64
Guaranteed	....	....	14.0	....	....	1.0	....
East Texas Trucker—							
Found	3.3	3.5	9.5	6.44	3.06	1.5	22.35
Guaranteed	3.0	3.0	8.0	....	....	3.0	....
Capital Fertilizer and Manufacturing Co., Jackson, Miss.							
Nonpareil—							
Found	2.3	3.3	9.53	6.27	3.26	0.67	19.58
Guaranteed	1.65	2.25	9.5	7.5	2.0	2.0	....

Name of Manufacturer, Location, and Brand.	Percentages.						Relative Value Per Ton.
			Phosphoric Acid.				
	Ammonia.	Potash.	Available.	Soluble.	Reverted.	Insoluble.	
Red Star Brand—							
Found	2.35	3.2	9.55	7.1	2.45	0.55	19.59
Guaranteed	1.65	2.25	9.5	7.5	2.0	2.0	....
High Grade Acid Phosphate—							
Found	....	....	13.93	9.82	4.11	0.62	13.52
Guaranteed	....	....	12.0	10.0	2.0	2.0	....
Our Vegetable Grower—							
Found	3.23	6.71	12.83	6.42	6.41	1.92	28.79
Guaranteed	2.5	4.0	9.0	6.0	3.0	2.0	....
German Kainit—							
Found	....	11.67	....	....	....	....	11.67
Guaranteed	....	12.0	....	....	....	....	....
Mayer Fertilizer and Junk Co., St. Louis, Mo.							
Anchor Brand Complete Fertilizer—							
Found	2.69	2.24	10.61	5.79	4.82	3.57	20.60
Guaranteed	2.0	2.0	9.0	....	....	2.0	....
Anchor Brand Bone and Potash—							
Found	2.0	2.0	9.7	6.2	3.5	5.5	17.65
Guaranteed	1.5	2.0	9.0	....	....	2.0	....
Anchor Brand Acid Phosphate—							
Found	....	....	14.47	10.75	3.72	5.28	14.10
Guaranteed	....	....	14.0	....	....	2.0	....
Shreveport Fertilizer Co., Shreveport, La.							
Caddo Cotton—							
Found	2.59	2.04	8.94	6.11	2.83	0.56	18.49
Guaranteed	2.5	1.0	8.0	6.0	2.0	1.0	....
Corn and Vegetable—							
Found	3.65	1.25	6.0	4.08	1.92	0.64	21.66
Guaranteed	3.5	1.0	6.0	5.0	1.0	1.0	....
Crown—							
Found	2.1	1.06	9.98	7.18	2.8	0.24	17.35
Guaranteed	2.0	1.0	9.0	7.0	2.0	1.0	....
Caddo Vegetable—							
Found	4.43	4.0	9.87	5.9	3.97	0.78	26.27
Guaranteed	4.0	4.0	8.0	6.0	2.0	2.0	....
Caddo Special—							
Found	3.2	7.85	6.93	4.11	2.82	0.32	23.72
Guaranteed	3.0	7.0	6.0	5.0	1.0	1.0	....
Star—							
Found	2.09	2.87	10.06	7.85	2.21	0.59	19.28
Guaranteed	2.0	1.5	10.0	....	....	1.0	....
Birmingham Fertilizer Co., Birmingham, Ala.							
Birmingham Acid Phosphate with Potash—							
Found	....	2.07	12.24	12.13	0.11	2.68	14.29
Guaranteed	....	1.0	11.0	9.0	2.0	....	....

LIVE STOCK SANITATION IN ARKANSAS.

By R. R. Dinwiddie.

For the control of contagious or "catching" diseases to which the live stock of the farm are subject more or less in all regions of the country, certain laws have been enacted both by congress and by the various State legislatures. Some requests have been received lately by the Experiment Station from officials in other States for copies of the State laws of Arkansas on this subject. Also, we have every year letters of inquiry from farmers of this State, proposing to move, who desire to know what are the existing restrictions on the shipping of cattle to other States or Territories, mostly Missouri, Kansas, Oklahoma, or Indian Territory.

It is well that farmers and, especially, shippers of live stock should be informed as to existing regulations in regard to both exportation and importation to and from other States. There is also need of a more general knowledge and observation of the law at present in force restricting the driving of cattle over the Texas Fever quarantine line within the State.

This Bulletin is issued for the purpose of supplying the information above referred to and also to describe more in detail the aid which the Agricultural Experiment Station is prepared to give in limiting or suppressing the spread of contagious animal diseases by means of the fund appropriated by the last legislature for this purpose.

Our information has been obtained by consulting the "Digest of the Statutes of Arkansas" (Sandals and Hill, 1894), and the "Acts of Arkansas" subsequent to this date, and by correspondence with the officials in other States having charge of Live Stock Sanitary matters.

There are perhaps few farmers in the State who know that there are any State laws relative to contagious stock diseases in Arkansas.

Two enactments (with amendments), however, can be found in the statute books.

AN ACT TO PROTECT THE HORSE, MULE, JACK, AND JENNET OF THE STATE FROM CONTAGIOUS DISEASES.

Be it enacted by the General Assembly of the State of Arkansas.

IMPORTATION OF DISEASED STOCK PROHIBITED. SECTION 1. If any person on persons shall wilfully and knowingly drive or bring into this State any diseased horse, mule, jack, or jennet affected by the disease known as "nasal gleet," glanders or farcy or any other contagious or infectious disease, or shall drive or ship from one part of this State to another, unless it be to remove from one piece of land or ground to another piece of land of the same owner, or if any person shall knowingly sell any diseased horse, mule, jack, or jennet they shall be deemed guilty of a misdemeanor.

PROHIBITED TERRITORY. SEC. 2. If any person shall bring into this State any Missouri or Western horses, mules, jacks, or jennets which have not been kept at least twelve months north of the northern boundary line of the State of Missouri and twelve months east of the west boundary line of the State of Iowa, he shall be deemed guilty of a misdemeanor: PROVIDED, That nothing herein contained shall be construed to prevent or make unlawful the transportation of such horses, mules, jacks, and jennets through the State on railways, or prohibit driving through any part of this State or being in possession of said horses, mules, jacks, and jennets between the first day of April and the tenth day of July following: PROVIDED further, That this Act shall not apply to actual *bona-fide* persons moving into this State and bringing their horses, mules, jacks, and jennets with them.

MISDEMEANOR, PENALTY. SEC. 3. Any person or persons, railroad company or owner of steamboats who shall violate any of the provisions of this Act shall be fined in any sum not to exceed three hundred nor less than one hundred dollars.

POWER OF LIMITATION OR EXTENSION. SEC. 4. That the Commissioner of Mines, Manufactures and Agriculture is hereby empowered and authorized to extend or limit the operation of this Act whenever in the opinion of said Commissioner the importation of horses, mules, jacks, and jennets of the class mentioned in this Act might transmit some of the diseases mentioned in this Act, or some other contagious or infectious disease.

SEC. 5. That this Act take effect and be in force from and after its passage and that all laws and parts of laws in conflict herewith be, and the same are, hereby, repealed.

Approved February 5, 1897.

This Act is evidently intended mainly to protect against the importation of glanders with the horses often brought in by the car load from Montana, Nevada and other western States. But it applies as well to animals driven over the State line and to native stock. According to its provisions the owner of glanders affected animals is prohibited from selling them, or from driving them on the public roads. In other words, he must keep them strictly on his own farm or premises under penalty, *provided he knows them to be so diseased.*

The provisions of the section 2 seem to prohibit the direct importation of any horses, mules, etc., whether diseased or not, from Missouri, or anywhere west of Iowa, during the greater part of the year.

TICK FEVER QUARANTINE LINE, 1899, 1901. (Sections 1 and 2 of the Act of 1899 are repealed by the amendments of 1901 so that the law now reads as follows):

ACT LIX. Be it enacted by the General Assembly of the State of Arkansas.

SECTION 1. That Section one (1) of an Act to locate and establish a district cattle quarantine line in the State of Arkansas, approved March 9, 1899, be amended so as to read as follows: That there shall be established by the State of Arkansas a district cattle quarantine line described as follows: Beginning at the northwest corner of Benton County and running thence south along the boundary line of this State to the southwest corner of Washington County, thence in an easterly direction following the southern boundary lines of Washington, Madison, Newton, Searcy and Stone counties to the northeast corner of Clebourne County; thence south along the line between Clebourne and Independence counties to the southwest corner of Independence County; thence east along the southern boundary of Independence County to the west boundary of Jackson County; thence north along the line between Jackson and Independence counties to the Lawrence County line; thence east along the southern boundary of Lawrence County to the southeast corner of Lawrence County; thence north along the eastern boundary of Lawrence County to the southern boundary of Greene County; thence east along the southern boundary of Greene County to the Missouri line.

SEC. 2. That all laws and parts of laws in conflict herewith be, and the same are, hereby, repealed, and that this Act take effect and be in force from and after its passage.

Approved March 22, 1901.

ACT XIII. Be it enacted by the General Assembly of the State of Arkansas.

SECTION 1. That Section two (2) of an Act entitled "An act to locate and establish a district cattle quarantine line in the State of Arkansas," approved March 19, 1899, be amended to read as follows: Said line shall be open to the free and unrestricted transfer of cattle, by driving or otherwise, across said line from and after the fifteenth (15) day of November of each year, and shall continue open until the first day of March the succeeding year, after which date it shall be unlawful to drive or transport any and all cattle across said line. PROVIDED, That this Act shall not interfere with the shipment of cattle by cars which are being transported across the State or territory included in said quarantined district.

SEC. 2. That all laws and parts of laws in conflict with this Act be, and the same are hereby, repealed, and that this Act shall take effect and be in force from and after its passage.

Approved February 16, 1901.

Act of 1899. (Sections 1 and 2 repealed.)

SEC. 3. Be it further enacted, That any person or persons found to be engaged in driving or transporting any cattle whatever across said line, or any person or persons found aiding or abetting in the driving or transporting of such cattle across said line during the period intervening between the first day of March and the fifteenth day of November in each year, except as provided for in Section one (1) Act XIII, be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum of not less than two hundred dollars ($200) nor more than five hundred dollars ($500) for each offence.

SEC. 4. To give full force and effect to this Act, it shall be the duty of any peace officer of this State who apprehends any person or persons violating this Act to have said party or parties arrested and brought before the proper authorities for a speedy trial; and PROVIDED further, That, in the prosecution of offenders under this Act by said peace officer, they shall not be required to give bond for cost.

SEC. 5. And any officer finding any cattle which have been driven across said line in violation of this Act shall, upon finding, seize and impound such cattle and hold them as security against all fines and cost of prosecution of the said owner of said cattle for the violating of this Act.

SEC. 6. Be it further enacted, That it shall be the duty of any officer upon finding such cattle, as soon as cost of prosecution, fine, etc., are settled, to drive said cattle back across said quarantine line as near the route over which they came as possible. Said officer to be allowed the sum of five dollars ($5) per day for such labor, and said sum to be paid by the parties violating this Act.

SEC. 7. That this Act take effect and be in full force on and after its passage, and that all laws and parts of laws in conflict herewith be, and the same are hereby repealed.

Approved March 9, 1899.

It is well known that cattle from the tick infested parts of the State will convey disease when moved into regions where ticks are not found. Tick Fever is a hot weather disease. It is not often seen in winter except far south of the quarantine line. In order to interfere as little as possible with cattle transportation the quarantine line is placed as far south as observation has shown to be safe. Cattle from *north* of the quarantine line can be moved anywhere *within the State* at any season of the year. Except during winter months cattle from *south* of the quarantine line, as defined in the Act, can not be driven north of it without infringing the law.

This is a useful law which, if enforced as it ought to be, would avert much of the loss from Tick Fever which occurs every year in the northern counties of the State.

SHIPMENT OF CATTLE OUT OF STATE. This is regulated by the laws of the Federal Government and by those of the State or Territory to which the shipment is made.

FEDERAL REGULATIONS ON THE SHIPMENT OF CATTLE FROM ARKANSAS. These are contained in B. A. I. Order No. 121 (dated Jan. 14, 1904), and amendments thereto. Those who wish more detailed information than can be given here should write for copies of these circulars addressing Bureau of Animal Industry, Department of Agriculture, Washington, D. C.

The substance of this order so far as it concerns Arkansas shippers is briefly as follows:

1. Defines the quarantine line across the United States. This line follows the northern boundary of Arkansas.
2. Provides for a modification of said quarantine line by a special order from the Secretary of Agriculture whenever any State or Territory establishes another quarantine line satisfactory to the Department of Agriculture and obtains the legislation necessary to enforce the quarantine and does strictly enforce it.
3. Forbids transportation of cattle over quarantine line from south to north, east or west, after February 1, 1904.
4. Allows such transportation by rail or boat for immediate slaughter and gives details of regulations for such shipments.
5. Cattle infested with southern cattle ticks shall be considered as infectious (whatever their origin) and shall be subject to the rules and regulations governing the movement of southern cattle.
6. Relates to stockyard and transportation companies.
7. Allows of shipment of southern cattle after dipping in Beaumont crude petroleum under supervision of an inspector of the Bureau of Animal Industry.
8. Relates to inspectors' duties.

9. "Violation of these regulations is punishable by a fine of not less than $100 nor more than $1000, or by imprisonment not more than one year, or by both such fine and imprisonment."

AMENDMENT NO. 9 TO B. A. I. ORDER NO. 121.

SPECIAL ORDER PERMITTING MOVEMENT OF CATTLE FROM TWO NORTHERN TIERS OF COUNTIES IN ARKANSAS (1904).

This Order, dated January 15, 1904, reads as follows: It is hereby ordered, That B. A. I. Order No. 121, dated January 14, 1904, be amended so as to permit the shipment of cattle for purposes other than immediate slaughter from the two northern tiers of counties in the State of Arkansas into the non-infected area; PROVIDED, That said cattle have remained in the above described counties since January 1 of this year and have been inspected by officers of the Bureau of Animal Industry of this Department and found to be free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof; that proper facilities have been afforded for making such inspection; and that after inspection the cattle shall be shipped without delay and without exposure to the infection of splenetic, or Texas fever.

PROVIDED, further, That no cattle shall be allowed shipment under this order unless accompanied by a written permit issued by an inspector of the Bureau of Animal Industry, nor shall such cattle be taken into any State or Territory contrary to the local regulations, and said permission will be granted only for cattle which are to remain within the State to which destined for three months after arrival.

This order to remain in force until April 1, 1904.

Applications for inspection of cattle under the provisions of this amendment should be made to Mr. Albert Dean, Room 328, Stockyard Station, Kansas City, Kansas. No charge is made for inspection by officials of the Bureau of Animal Industry.

OKLAHOMA.

RESTRICTIONS ON THE IMPORTATION OF CATTLE FROM ARKANSAS.

The Territory of Oklahoma is crossed from east to west by the Federal and Territorial quarantine line. Besides the Federal regulations above described which are in force here, Rule XII of the Live Stock Quarantine Proclamation, dated May 18, 1903, reads: "No person or corporation shall be permitted to drive, lead, move, drift, or in any other manner transport cattle into that part of the Territory of Oklahoma north and west of the quarantine line described in Rule IX of these rules and regulations from any point outside of the Territory of Oklahoma above said quarantine line, unless said person or corporation possesses a certificate of health from an authorized Inspector of this board showing said cattle to be free from infection.''

Rule VII. Requires that all equine stock (horses, etc.), admitted into the Territory of Oklahoma must be accompanied by a certificate from an accredited veterinarian showing said stock to be free from Glanders or any other contagious disease.

A letter from the Secretary of the Oklahoma Live Stock Sanitary Commission (Thomas Morris, Guthrie, O. T.), states that above rules will hold good until new ones are promulgated and that there will be very little change, if any, in the rules for 1904.

KANSAS.

(Bulletin of the Live Stock Sanitary Commission, Dated Oct. 7, 1903.)

In this State, which lies north of the Government quarantine line, cattle from Arkansas (except those shipped for immediate slaughter) are admitted from November 1 to January 31, only after inspection ''by an Inspector duly appointed by this Commission or by the Bureau of Animal Industry,'' and at certain designated places of entry. The Secretary of the Commission is F. H. Chamberlain, Sedan, Kansas.

MISSOURI.

(Cattle Quarantine Proclamation, Dated Dec. 22, 1903.)

Arkansas cattle are admitted as natives during the months of November, December, January, February and March ''or during such time as is provided by the Federal quarantine regulation for the admission of southern cattle'' after examination by ''a live stock inspector of this State or by a duly authorized agent of the Bureau of Animal Industry of the United States Department of Agriculture.''

Live Stock Sanitary affairs are under the supervision of the State Board of Agriculture; State Veterinarian D. F. Luckey, Columbia, Missouri.

INDIAN TERRITORY.

All of Indian Territory lying within the quarantine district, Arkansas cattle can be moved there without restriction. It ought to be remembered that cattle from northwest Arkansas (the two northern tiers of counties of Arkansas) are not immune to tick fever and are likely to die from this disease when moved into the Nation. Some parts of Indian Territory in the north may be free from infection but these have not been accurately located and the boundaries officially defined.

Movers from northwest Arkansas to the Indian Territory should first dispose of their cattle or else inform themselves by inquiry in the locality to which they propose to move whether or not northern raised cattle can be moved here with safety. Neglect of this precaution has resulted in considerable loss to movers from this locality during the last few years.

VETERINARY INSPECTION BY THE AGRICULTURAL EXPERIMENT STATION.

(This work in charge of R. R. Dinwiddie, Veterinarian; J. F. Stanford, Assistant.)

In those States in which the live stock interests predominate the control of contagious animal diseases is generally vested in a State Live Stock Sanitary Commission acting under expert (veterinary) advice, and supported in their work by adequate legislation. In the absence of any such official machinery in this State the Agricultural Experiment Station attempts to supply the first essential in this work, namely, the identification of outbreaks of disease, and by instruction and advice to place the owners of diseased stock and the community in a position to intelligently assist themselves. The Experiment Station, however, is not charged with the duty of enforcing the live stock sanitary laws. There are two such laws in this State (as seen in preceding pages) both of which contain some good features (along with others which are very irrational). Their enforcement, in part at least, would certainly diminish the losses from the two diseases against which they are directed—Glanders and Texas or Tick Fever.

An item of one thousand dollars for two years was allowed by the last legislature, in the University appropriation, for the purpose of covering the expenses of the Experiment Station Veterinarian in responding to calls for his services in identifying outbreaks of disease in live stock and assisting in their suppression or control.

In order that the greatest benefit possible may be derived from the expenditure of this fund, which will be absorbed mainly by traveling expenses, only those outbreaks of disease will be visited by the veterinarian or his assistant which involves or threatens to involve a considerable number of animals. Diseases affecting one or only a few animals, or confined to one farm, will receive the customary attention from the Experiment Station by correspondence.

To avoid the expense of unnecessary trips, all applications for veterinary examination (or even advice) should be accompanied by a full description of the extent of the disease and its symptoms. The applicant, if a personal visit is required, should be prepared to lend what aid he can to the veterinarian in making his examinations.

In the case of contagious diseases such as glanders which involves risk to other stock in the neighborhood he will be expected to act upon the advice offered as to quarantine or destruction of diseased stock.

No compensation is allowed by the State for animals destroyed on account of contagious disease. The law here really does not call for the destruction of any diseased stock, but it requires their isolation when there is danger of infecting others; and when the owner has received expert advice and wilfully neglects this precaution he lays himself open to the penalty which the law provides, since a plea of ignorance can not then be advanced.

The thorough control of contagious stock diseases in this State can not be expected until more rational sanitary laws are obtained and more effective methods of enforcing them. But we expect by judicious use of the funds made available for veterinary inspection, along with the co-operation of those directly concerned, that considerable loss may be averted and the farming population educated to an appreciation of the value of compulsory live stock sanitation. The necessary legislation will then easily be obtained.

The following form has been made out for the use of those applying to the Experiment Station for veterinary service where a personal visit seems to be necessary. Printed copies with blank spaces for reply will be sent on application.

ARKANSAS AGRICULTURAL EXPERIMENT STATION.

APPLICATION FOR EXAMINATION OF DISEASED STOCK.

This form will be mailed on application. It should be filled out and returned, the envelope being addressed to

R. R. DINWIDDIE,
Agricultural Experiment Station, Fayetteville, Ark.

Name and postoffice address of applicant.
Nearest railway station.
Distance from station.
How long has disease prevailed?
In what kinds of animals?
How many of your own are affected?
How many have died?
Are any of your neighbors' stock affected? If so, give names.
Give as full a description of the symptoms as you can.

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AGRICULTURAL EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

EIGHTEENTH ANNUAL REPORT

1905

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AGRICULTURAL EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

EIGHTEENTH ANNUAL REPORT

1905

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ARKANSAS EXPERIMENT STATION,

FAYETTEVILLE, ARK., September 1, 1905.

To His Excellency, JEFFERSON DAVIS,

Governor of Arkansas:

SIR—

I have the honor to transmit to you herewith the Eighteenth Annual Report of the Arkansas Agricultural Experiment Station.

Most respectfully,

W. G. VINCENHELLER,

Director.

Agricultural Experiment Station.

BOARD OF TRUSTEES.

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BOARD OF CONTROL.

Committee on Agricultural Department, President of the University, Director of the Station.

STATION STAFF.

W. G. VINCENHELLER	DIRECTOR.
R. R. DINWIDDIE	Pathologist and Bacteriologist.
GEO. A. COLE	Agriculturist.
ERNEST WALKER	Horticulturist and Entomologist.
JOHN H. NORTON	Chemist.
V. A. HOOPER	Dairy and Live Stock Husbandry.
EDITH BLACK	Executive Clerk.

Correspondents should notify the Director of any change of Post Office Address, error in Address, or failure or delay in Receiving Bulletins.

W. G. VINCENHELLER, Director.
Fayetteville, Ark.

REPORT OF DIRECTOR.

The published experiments of the Station for the year 1905 appear in full in succeeding pages of this report. The year's experimental work was published in five bulletins, which were mailed to all addresses on the Station's mailing list. A total of 50,000 copies was mailed out. The subjects of the bulletins are as follows:

Bulletin 83—Broom Corn Suggestions. By C. L. Newman.

Bulletin 84—Peanuts. By C. L. Newman.

Bulletin 85—Cotton Food Products in Hog Feeding. By R. R. Dinwiddie.

Bulletin 86—Asparagus and Salt Fertilizers. By E. Walker and A. M. Muckenfuss.

Bulletin 87—Glanders in Horses. By R. R. Dinwiddie.

The financial statement of receipts and expenditures for the year appears below.

W. G. VINCENHELLER,
Director.

FINANCIAL REPORT

Agricultural Experiment Station.

In Account with the United States Appropriation.

1905. DEBIT.

To receipts from the Treasurer of the United States as per Appropriation for the year ending June 30, 1905	$13,163.45
	$13,163.45

CREDIT.

By Salaries	$7,988.79
Labor	2,071.90
Publications	407.08
Postage and Stationery	109.32
Freight and Express	221.04
Heat, Light and Water	75.05
Chemical Supplies	152.64
Seeds, Plants and Sundry Supplies	624.04
Fertilizers	85.75
Feeding Stuffs	150.55
Library	64.63
Tools, Implements and Machinery	.00
Furniture and Fixtures	47.00
Scientific Apparatus	4.66
Live Stock	631.50
Traveling Expenses	204.00
Contingent Expenses	98.00
Building and Repairs	227.50
	$13,163.45

The foregoing statement is copied from the Experiment Station books, which have been examined and approved by the Auditing Committee of the Board of Trustees.

W. G. VINCENHELLER,
Director.

BROOM CORN SUGGESTIONS.

By C. L. Newman.

More than half of the broom corn produced in the United States is grown in Illinois. Kansas, Missouri and Oklahoma produce more than all other states and territories combined, excluding Illinois.

Within the past few years the price of broom corn has undergone unusual fluctuations, ranging from about $70 per ton to as high as $200. On years following an unusually high market many undertake the culture of this crop who have but slight and inaccurate knowledge either of the requirements of the plant or of the practical details beginning with the selection of the seed and the soil and ending with the baling and marketing of the brush. Such attempts are usually followed by an increased production of inferior and poorly handled brush and little if any profit to those who have been induced by high prices to embark in an undertaking without the necessary knowledge or preparation for its successful prosecution. Prospective growers of broom corn have written the Experiment Station for directions for growing the crop, and with the expectation of securing by letter all the information necessary to the attainment of successful and profitable results.

The object of this bulletin is to supply so far as we can, information to those who are beginners in broom corn growing that they may avoid some common mistakes and not overlook or neglect some operations necessary to success.

The Experiment Station has grown three crops of broom corn at Fayetteville and has tested varieties of both the dwarf and standard sorts. The lowest yield of cleaned and cured brush was a little more than 1-6 of a ton per acre secured from the California Golden, a dwarf variety, and the highest was a little less than ½ ton produced by the Tennessee evergreen, a standard variety. With the necessary care, attention and equipment this crop may be made a profitable one in localities in the state producing 25 or more bushels of corn per acre, and upon less fertile soil with judicious rotation and fertilization. Broom corn is now quite extensively grown in Oklahoma, and has been for some years in Missouri. Its successful profitable culture has been demonstrated in Tennessee and Texas.

The climate of Arkansas is admirably suited not only to the growing of this crop but also to its harvest. Abundant rains in the early stages of its growth induce a vigorous plant, and dry weather at harvest time, which is the most critical period in the growth of the crop, is necessary to the production of high grade brush. Rain at this time will redden the uncut brush and cause the loss of its bright green color after it has been cut. Harvesting is done in August, September and October when usually there is little rain, and the weather conditions most favorable for curing in first-class condition.

GROWING THE CROP—THE SOIL.

While soil that will produce good crops of corn and sorghum may be depended upon for a good crop of broom corn, it is very necessary that the previous treatment be such as will as near as possible destroy the weed seeds that may be in the soil, since the presence of weeds greatly interferes with the proper cultivation of the young broom corn plants and with their early growth. Sandy or even gravelly soils are well suited to broom corn, but they must be thoroughly drained. Undrained land not only induces an irregular, slow and inferior growth but makes cultivation more difficult and causes the red color in the brush, which may reduce its market value $20 or $40 per ton.. Uniformity of soil character, fertility and exposure, will induce uniformity in ripening.

THE SEED.

The peculiar growth of the seed head of broom corn is abnormal and artificially developed, mainly by seed selection. Its value for the manufacture of brooms is due to the characters of the panicle associated with this induced growth. That these artificially developed characters may be reproduced and improved, careful selection of the seed is necessary, not only for one crop but for each crop. There is a constant tendency towards reversion to undesirable form, and seed from only the most desirable individual plants should be reserved for planting, if the grower produces his own seed. The majority, however, will purchase their seed of seedsmen. Unfortunately the seed business affords almost an unlimited field for fraud. The purchaser of seeds of whatsoever kind can best protect himself by dealing only with firms of established and known reputation. When the grower has become familiar with the many details of broom corn culture it will probably be to his advantage to grow his own seed if he is determined to give the matter the necessary care. If he grows his seed in an isolated patch with good soil, good cultivation and careful selection he may improve the quality of his brush. To do this it is necessary that the undesirable heads be removed before they blossom and pollenize the desirable ones, which alone should be allowed to ripen seed. It is important that broom corn grown for seed should not be planted near sorghum, since the close botanic relation of these plants permit them to cross readily, thus reducing the value of either crop grown from crossed seed.

If the seed are fresh and nine out of ten germinate, two or three quarts are sufficient to plant an acre, if a suitable seed drill is used. If the seed are dropped by hand, as is frequently the case with small growers, they are not properly distributed, there is an unavoidable waste of seed, irregular development in the resulting crop, and increased difficulties in cultivating the young plants.

There are two classes of broom corn grown, the dwarf and the standard. The dwarf grows from 4½ to 6 feet tall and the standard from 8 to 12 feet, with longer and stronger brush than the former. These differences make it necessary that the two classes be in some respects treated differently, as will be discussed in appropriate place.

PLANTING.

In the southern portion of the state, planting may be done early in April, but in the extreme northern counties it should be deferred until the first of May or later. In no case should planting begin until the soil has become thoroughly warm, since broom corn is more susceptible to cold than Indian corn, and equally as susceptible as sorghum and millet. If planted too early the seed are not only liable to rot in the soil or germinate poorly, but the plants that do appear will be weak and the stand and growth irregular. With those having no experience with broom corn growing it is preferable that they delay planting until it is safe to plant cotton and cowpeas. When the young plants first come up they are slender and delicate, growing very slowly the first two or three weeks. This early slowness of growth is more marked with early planting and cool weather than with later planting in warm weather. One of the most necessary and profitable operations in the growing of any crop consists in the thorough preparation of the soil before the crop is planted, and this is particularly true of broom corn. Two or three cultivations at intervals of ten or fifteen days before planting will go a great way towards the destruction of the growths of young weeds that successively spring up as the weather becomes sufficiently warm for their germination. Each shower at this season of the year will start a new crop of weeds and as soon after rain falls as the ground is dry enough for cultivation the weeder, harrow, cultivator, disc or some such surface working and weed destroying implement should go over the field with as much care and thoroughness as if the crop was already growing. This preparation—cultivation not only destroys the first few crops of weeds but gives to the soil a physical character that will manifest itself in the quick germination of the seed into strong and rapidly growing young plants, facilitating their future cultivation and growth.

Broom corn rows are usually about 3½ feet apart, though the dwarf forms may be given 4 or 6 inches less space. The distance the plants should stand in the row depends upon the fertility of the land and as to whether the dwarf or standard varieties are grown. They should be thicker on fertile land, about four plants to the foot for the standard and about six for the dwarf should be the distance for plants to occupy in the row for soil of medium fertility. On more fertile soil the stand may be thicker, and thinner on less fertile soil. If the crop is to be cultivated with the hoe the seed are planted in hills 15 to 20 inches apart with four to six stalks of standard and six to ten stalks of dwarf to the hill. A regular or uniform stand is necessary to secure a uniform quality of brush. Just such quantities of seed should be sown as will give the desired stand with as little thinning as possible. It is necessary to have the best seed and the best preparation for the attainment of this. Some broom corn growers sow a superfluous quantity of seed and thin to a stand, but thinning broom corn is a tedious and expensive task, and one that is frequently neglected, as is the case with sorghum. Corn planters with plate holes small enough for broom corn seed may be employed for planting. The seed should be covered from ½ inch to 1 inch deep, the depth depending upon the character of the soil and the quantity of moisture in the soil at the time of planting. If the soil is dry when the seed are sown they should be covered deeper than would be necessary if the soil was in good moist condition. Plantings made late in May or in June should be made deeper than those made early in May or in April. Rolling the soil as the seed are planted will insure a more prompt germination and a better stand. This is particularly true when the soil is dry at seeding time. Should a heavy rain occure before the seed have germinated the field should be gone over broadcast with a weeder or harrow as soon as the soil will admit. This prevents the formation of a crust and hastens the germination of the seed.

MANURING AND FERTILIZING.

As to whether fertilizing broom corn will or will not pay is a matter to be determined by each grower after a careful examination into the characters and condition of the soil. Where cotton seed meal may be cheaply procured it will be an appropriate and desirable fertilizer. An application of from 200 to 400 pounds of cotton seed meal in the drill before planting, or of 75 to 160 pounds of nitrate of soda just before the first cultivation would hasten the growth of the young plants when they most needed stimulation. Such results were quite strongly indicated by nitrate of soda applications in tests made at the Experiment Station on sandy soil. Muriate of potash appeared to not only increase the yield on the same character of soil but to also have a tendency to check the reddening of the brush and increase its rigidity. These tests are to be repeated with the hope of verifying the above observations. Fertilization that has been successful and profitable with sorghum, Kaffir corn or Indian corn would be appropriate for broom corn.

A crop of cowpeas following oats, rye, wheat or Irish potatoes would improve the soil for broom corn to be planted the following spring not only be the enrichment of the soil but by being a means for aiding in the suppression of weeds. Where crimson clover does well the cowpeas may be followed by this crop. The clover may be harvested in May (in April in the southern part of the state) and the soil prepared and planted to broom corn. This has been tried on the Station grounds and with success, notwithstanding a poor catch of clover. Broom corn has also been grown with success on soil from which rye and vetch and Irish potatoes had been harvested. Following such crops the greater ease with which the young broom corn was cultivated was quite apparent, there being a marked decrease in the weeds that usually interfere with the cultivation of the young broom corn.

CULTIVATION.

After broom corn has attained a height of six or ten inches its cultivation need not differ from that usual with Indian corn or drilled sorghum. Its growth is then rapid and an occasional cultivation for the purpose of maintaining an earth mulch and preventing the growths of weeds that might appear is all that is necessary. To give proper cultural care while quite young is more difficult. This difficulty can, however, be greatly obviated by as far as possible ridding the soil of weeds the year previous, and by several cultivations of the area intended for broom corn before the seed are planted.

When the young plants first appear they are small and not dissimilar in appearance to young foxtail grass. Unless the soil has been made comparatively free from the seeds of such weeds as crab-grass, rag weed, pig weed, foxtail and others, cultivation must begin with the appearance of the young broom corn plants and be prosecuted vigorously and frequently, or these weeds may successfully contend for the possession of the soil. It is frequently possible to go over the field once or twice with a weeder after the broom corn is planted and before it is up, thus destroying many weeds or so checking their growth as to give the more slowly germinating broom corn an equal start.

Harrows, weeders and cultivators (with sidebars to protect the plant from being covered with soil) if used frequently after the young plants show along the row will greatly lessen the labor of hoeing.

Old stalks of weeds, corn, sorghum, broom corn and the like will seriously interfere with the cultivation of this crop, and such trash should be gotten rid of before the broom corn is planted.

Cultivation should be of such frequency as not only to destroy all weeds before they have attained a size that would injure the broom corn or interfere with the ease of their destruction, but also to prevent the formation of a crust upon the soil surface and to maintain a high degree of tilth which will benefit the crop more than the weeds will injure.

If the plants are found to be too thick the surplus should be removed when the first hoeing is done.

INJURIOUS INSECTS.

Broom corn is subject to attack by such insects as are injurious to sorghum. Only two kinds have been particularly troublesome on the station grounds at Fayetteville. These were the aphis and the chinch bug. The stimulating effects of fertilizer, frequent shallow cultivation and crop rotation will usually prevent any great damage from the aphis, but the chinch bug is more difficult to control. The early cultivation suggested before the broom corn is planted will lessen the damage from the chinch bug by destroying the food of the first adult females that appear in case they hibernate in or near the field intended for broom corn. If any crop upon which the chinch bug feeds, such as wheat, oats and rye, should be near the broom corn field, precaution should be taken to prevent the migration of the bugs from these crops when they are harvested to the broom corn.

Rotation, frequent shallow cultivation and fertilization are of some benefit in combating the chinch bug. When they first appear on the margin of a field a prompt application of kerosene oil either in emulsion or as a mechanical mixture with water, will destroy at least a large portion of them and serve as an important check to their propagation and ravages.

In some sections a smut has caused considerable injury to broom corn. If before planting the seed are immersed for fifteen minutes in water heated to 135 degrees F. there will be little if any trouble from this source. It is advisable to take this precaution as there is nothing difficult in the operation, and since the spores of the disease from which infection arises are introduced into the field with the broom corn seed, to which they adhere.

HARVESTING.

The inexperienced grower of broom corn will encounter more difficulties in the manipulation of the crop after it is ready for the harvest than before. Experience is the most valuable equipment that he may possess. The time to harvest, the method of harvesting, sorting, threshing, curing, baling, and marketing, all, if properly done, require experience. An excellent crop may be brought successfully to the harvest and yet unprofitable on account of inattention to or ignorance of some apparently unimportant detail.

In undertaking the growing of broom corn it should be done with the determination to continue in the business for a period of years, otherwise the crop had better be abandoned before the first supply of seed is purchased. Any well equipped farm should have all the tools and other equipment necessary for planting and growing broom corn, but especial preparation must be made for caring for the brush from the harvest to the baling of the product.

WHEN SHOULD THE BRUSH BE HARVESTED?

In the first place the seed should be planted at such a time as to insure that the harvest fall when other work of the farm is not pressing. Such a time in Arkansas would fall in August or September, when the cultivation of spring sown crops is suspended and small grain has been harvested; and before the gathering of corn and cotton or the sowing of fall crops. At this period of the year there is a greater surety of having favorable weather for harvesting and curing operations, and suitable weather is indispensable to curing into the best quality of clear green brush.

To secure the color demanded by the market broom corn must be harvested between the time of blossoming and what is known as the ''dough'' stage of the seed or when the pollen and *anthers* shatter from the panicle. At this period of growth the brush is supposed to possess the most desirable qualities of color, uniformity, elasticity and durability, and if harvested at this time will command a better price than if harvested earlier or later.

TABLING AND CUTTING OF STANDARD BRUSH.

On account of the great difference in the habit of growth the methods employed in harvesting standard and dwarf varieties are quite different. Dwarf broom corn is usually 5 or 6 feet tall, but the standard is usually 8 to 12 feet, and sometimes 16 feet tall. The standard yields about a third more per acre than the dwarf, but requires more labor and is of greater inconvenience in harvesting.

That the difficulties of harvesting the standard varieties may be lessened the stalks of two rows are bent at about three feet from the ground so that the upper parts of the stalks are parallel with the surface of the ground and extend diagonally across the ''middle'' between the two rows thus ''tabled,'' as this bending of the stalks is called. The stalks of two adjacent rows are bent in opposite directions, the heads of brush thus being brought so that they extend 20 or

25 inches into every alternate middle. This brings the heads into position convenient for the next operation, that of cutting. Six inches of stalk is all that is necessary to leave with the brush. The operator passes along the space between two tables, cuts the brush wlth a sharp thin bladed knife and lays in handfuls the product of four rows upon every alternate two-rowed table. The other two alternate rows serving as a driveway for wagons to pass in loading and hauling the brush from the field. If the lower end of the brush or head is enclosed within the sheath of the upper leaf it should not be moved when the brush is cut. A little practice will enable one to cut only part of the way through the sheath in severing the stalk.

In hauling from the field the wagon is driven over the empty table and the brush loaded from both sides, lapping the stem ends in the middle to bind the load. A wagon frame with end guards and no side boards will be found handy.

PULLING THE DWARF BRUSH.

The lower part of the dwarf heads is habitually enclosed within the sheath of the upper leaf. Rain or dew is liable to collect within this sheath to the injury of the brush. This enclosing sheath necessitates a method in removing the heads from the dwarf varieties differing from that practiced in cutting the standard. This consists in pulling the brush by hand. The heads are grasped near the sheath and a vigorous pull severs them at the first joint and the troublesome sheath remains upon the stalk. The heads of the dwarf varieties mature irregularly and it is necessary that the field be gone over a second time and sometimes a third time that the harvesting may be done when the brush is at the proper stage of maturity for curing into brush of the best quality.

SORTING.

A few crooked, stained, coarse or irregularly formed brush scattered through that of good quality will lower the market value of the whole crop. Heads of very low grade should not be cut or pulled, but allowed to remain in the field. Crooked brushes are caused by delaying the harvest until the seed have developed sufficient weight to bend the heads over, and by the weight of water adhering to the seed and straw in time of rain.

The most convenient time for sorting is when the brush is in the field when it should be separated into at least three grades. The proper sorting of the brush will frequently add a fourth to its market value. If sorted in the field the brush should be hauled in immediately after the sorting is done. Rain, dew or sunshine may change its grade if exposed to their action.

THRESHING OR CLEANING.

If broom corn is grown in any considerable quantity a threshing machine made for the purpose should be provided. These cost about $150.00 and are operated by steam or horse power. When only a small quantity is grown simpler though slow and tedious devices may be resorted to. An ordinary curry-comb with long teeth, a wooden comb made by sawing teeth in the end of a board which is to be securely nailed to the end of a bench, and sharp edged short sticks may be used in scraping the seed from the brush.

The modern machines made for threshing broom corn will clean the brush from about 25 acres in a day. In the broom corn sections such machines go from farm to farm and clean the crop at a stipulated price—$2 or $3 per acre. It is important that all the seed be removed from the brush since the manufacturer will not pay full price for brush that must be recleaned.

From the time broom corn is cut to its baling it is necessary that it be handled repeatedly. Throughout all this manipulation the greatest care should be exercised to keep the brush straight and smooth and prevent its becoming tangled, since such a condition will naturally decrease its value.

DRYING.

When broom corn is grown for market, sheds are constructed for the purpose of curing the crop. The location of such sheds should be dry and convenient. The sheds are usually 16 feet wide, 10 to 12 feet high and of a desired length. Such a shed 32 feet long will afford room for curing the product of 25 or 30 acres. The shed must be covered with a good roof, the eaves of which should extend beyond the sides and ends. Good ventilation is necessary. It is well to provide wood shutters or canvas to protect the brush while curing, since rain may not only do serious damage but is liable to ruin a large part of the crop. While drying, light should as far as possible be excluded from the brush since it will destroy the green color so necessary to securing a high price. The frame work that supports the roof of the shed should be in three parallel rows, one row in the center and one on each side, and so placed as to divide the shed into 8 by 8 foot sections for convenience in making the slat shelves upon which the brush is placed for drying. To this framework or uprights are nailed narrow strips 4 to 6 inches apart and running across the shed or in opposite directions to that of the roof. At suitable distances upon the strips and at right angles to them, movable strips are placed in pairs, upon which the brush is laid. The first of these movable strips are placed upon the lower nailed cross strips, beginning at the center of the shed, working outward each way to the sides. A shelf is thus formed upon each pair of the nailed cross strips. As the shelves are made the brush is placed upon them to a depth of two or three inches. These layers should be of uniform thickness and the brush laid on straight. If the layers are too thick the brush will not only cure slowly and iregularly, but is apt to damage. The length of time required for curing varies with the weather conditions and may be ten days or it may be thirty. Slow curing is detrimental to the quality of the brush.

The completion of the process of curing may be determined by selecting some of the heavier stems near the center of the shed and bending and twisting them. So long as water can be twisted from them they should remain in the shed. When not in use for curing broom corn the sheds may be serviceable for storing hay, forage, and tools, or for packing sheds for other crops. It may be well to have in mind their probable use for other purposes when being built. A shed such as the one described above, with a slight alteration in the size or strength of the nailed cross pieces, and in the spacing of the slats, would serve admirably for curing cowpea hay as recommended in bulletins Nos. 27 and 61 of this station. Farms well supplied with barn room, wagon shed, gin house, or such structures need not go to the expense of constructing special sheds, but with a good roof and ventilated room the slat shelves are all that is lacking of the equipment for curing.

BALING.

If the brush is not to be baled as soon as taken from the drying shed it must be bulked in a dry barn or other building where the light may be excluded to prevent bleaching. It is very necessary that drying be perfectly done before the brush is baled, otherwise it may become mouldy, deteriorate in quality, and not bring so good a price when marketed.. All brush should be thoroughly cleaned before baled, otherwise it must be disposed of at a reduced price since the manufacturer must reclean before brooms can be made.

Baling is usually done by horse power. The press may be purchased, or with a little mechanical ingenuity may be built at home. The brush is placed evenly with stalk end out, the panicles lapping in the center of the bale, which, when tightly pressed is bound by five strands of No. 9 wire. The bales are usually 44 and 46 inches long, 26 inches thick, and from 36 to 44 inches deep. The depth depending upon the filling of the press. The bales usually weigh 350 pounds, though they are found on the market that weigh less than 300 and others as heavy as 400 pounds. They should, however, be uniform in size, shape and weight.

MARKETING.

Broom corn grown at a distance from the market or a broom factory, or in small quantity, would be difficult to dispose of unless the grower manufactures his crop into brooms. It is safer, and better prices are secured by selling direct to the factory. As is the case in any business if the producer markets an article of good quality, properly graded and honestly packed, he will secure good prices if there is a demand for the article he wishes to dispose of. The grower should become familiar with the demands of the market and strive to meet these demands. He should become familiar with the different grades that he not only may produce the best, but separate it from the inferior grades and bale each separately.

PEANUTS.

By C. L. Newman.

The cultivation of the peanut for stock food has within recent years been given considerable attention in various localities in the South, and each year its popularity has increased. The larger varieties of peanuts, such as are usually found in confectionery stands and are sold everywhere as parched peanuts, are more fastidious in their soil requirements than the smaller but more prolific Spanish variety. The larger varieties are sold under the names of Virginia White, Virginia Red, Tennessee White and Tennessee Red, and require a certain amount of lime in the soil for the production of a profitable crop. A soil naturally calcareous is far preferable, but good results may be secured from non-calcareous soils by the artificial application of an adequate quantity of lime. The Spanish peanut will grow well on almost any soil that is not too wet at some period of the peanut growing season. It succeeds well in the sandy pine flats of South Arkansas, in the rich alluvial river bottoms, in the prairie regions, and in the mountain sections. So far as the writer's experience and observation extends the Spanish peanut will not only succeed, but make profitable returns wherever the cowpea will succeed.

On many of the worn and infertile sandy soils throughout the State this variety of peanut will produce a heavier yield of both grain and forage than corn, with less probability of failure, and in a shorter period of time.

The peanut, like the cowpea, clover, alfalfa and other legumes, is rich in nitrogenous constituents and exercises a beneficial effect upon the fertility of the soil, through its power to utilize atmospheric nitrogen.

Like the cowpea and soy bean the peanut is decidedly drouth-resistant, and will produce profitable crops in seasons of drouth when many of the graminaceous plants fail.

For ten or fifteen years the station has grown annual crops of Spanish peanuts and various other varieties for a large portion of this time. As a hog food nothing has been found that will more cheaply produce a gain in weight equal to that produced by the Spanish peanut. As compared with corn, the standard hog food, one-fourth of an acre of peanuts produced 313 pounds of pork, and the same area in corn produced only 109 pounds of pork—a difference of nearly three hundred per cent in favor of Spanish peanuts as compared with corn. (Ark. Agr. Ex. Sta., Bul. No. 73.)

"The Alabama Station investigated the relative value of pasturing hogs on peanuts, chufas, cowpeas, rape, sorghum and sweet potatoes, and found that the average amount of gain required in connection with the pasturage to make one pound of growth, was 1.77 pounds with peanuts, 2.30 pounds with chufas, 2.68 pounds with rape, 3.07 pounds with cowpeas, 3.13 with sweet potatoes and 3.70 with sorghum. Seven pigs averaging in weight 28.10 pounds gained in six weeks on peanut pasture alone 503 pounds per acre gained."

In the fall of 1903 five Tamworth hogs, aggregating 895 pounds, were pastured for 20 days upon Spanish peanuts. At the end of the 20 days they weighed 1124 pounds, the five gaining 229 pounds or 45.8 pounds per hog in 20 days. The average grain of each hog was 2.29 pounds per day.

Cattle, horses, and poultry, as well as hogs, are fond of peanuts and thrive upon them. Cattle and horses eat the whole plant and poultry and hogs the nuts, and even the leaves in the winter. Turkeys swallow the whole pod, but chickens, ducks and guineas beat the nuts out, rejecting the hull.

The fact that Spanish peanuts will produce large crops on comparatively poor sandy soils should encourage their more extensive growth as a substitute for corn; or at least to supplement the grain crops when there is a shortage. In south Arkansas the Spanish peanut planted as late as the first of August will mature a good crop.

THE SOIL AND ITS PREPARATION.

Soils that will produce excellent crops of the Spanish variety are not necessarily suited to the varieties grown for parching and for confectionery purposes. If there is a deficiency of lime there will be a large proportion of "pops" or empty pods. If the soil contains much iron the pods will be colored and will not bring the highest price. The color of the pods is influenced by the color of the soil in which they are grown. A gray or light sandy soil is best. It should be warm, well drained, friable or loose, and not inclined to run together or bake. Almost any soil with an adequate quantity of lime in it that is friable and will remain so throughout the growing season, will produce good crops of the larger varieties. However, some dark or clayey soils will, if sufficient lime is present, produce heavier yields than more desirable soils; but, crops grown on such soils are more difficult to cultivate, harvest, and prepare for market, and the staining of the pods detracts from the market value.

Soils with any considerable quantity of decomposing vegetable matter should be avoided, if the crop is grown for market, since stable manure, green manures and the like have a tendency to make the peanut plant "go to vine," but increases the number of unfilled pods and not infrequently causes the nuts to rot in the ground. If such manures were to be used upon soil intended for the peanut they should be applied sometime before the peanuts are planted, and preferably to the preceding crop. Peanuts should follow some hoed crop such as cotton, corn or tobacco, that the soil may be as clean as possible. The avoidance of vegetable matter in the soil is not so necessary for the Spanish peanut as it is for the Virginia varieties; and since larger yields may be secured, green manuring may not be objectionable when the peanuts are grown for grazing or for forage.

The preparation of the soil does not differ from the approved method employed for corn, but should be more thorough to insure a thoroughly fine and mellow soil condition. The breaking should be deep and some time before the seed are planted. Just before planting the soil should be again thoroughly broken with disc, cultivator, double shovel, or some surface working implement, and the preparation completed with drag, or rather followed by harrow or disc until it is in a thoroughly pulverized condition. Some throw together a broad bed while others plant on the level ground, getting the seed down in any way that is expedient. The practice at the station has been to plant on a level, covering the seed not more than one inch if the soil is in good condition as regards moisture, and as deep as two inches when late plantings are made in dry weather. When the seed are planted on a level there is necessarily some shifting of the soil to the rows at each cultivation. The rule of some peanut planters is to throw up a slight ridge, so that the seed when planted one or one and a half inches deep will be at the general level of the ground.

PLANTING.

The Virginia and Tennessee as well as the Spanish are usually dropped by hand. Some corn and bean planters, however, may be so adjusted as to plant the Spanish and do satisfactory work.

Before the seed are planted they should be tested as to their germinating power. It is not infrequently the case that the seed have become defective through heating or moulding while on the vine, or heating after they have been picked and bulked. If such is the case not more than half a stand may be secured and replanting is never satisfactory. To avoid a poorer stand from defective seed a test should be made before the time to plant approaches and the per cent of sound seed determined. This may be done by counting out one hundred seed and planting them in a warm soil well prepared and counting the number that germinate. Another method is to count out twenty-five or fifty seed, place in jar or on deep plate with moist cloth or cotton and set where the temperature will be uniform and warm enough to start germination. In three days the seed will have begun growth. Having determined the per cent that germinates the quantity of seed planted may be regulated so as to compensate for the defective seed.

Shelling peanuts for planting is a tedious task and when the Spanish variety is grown this is sometimes dispensed with, and the whole pod planted or the pods broken in two parts. Only good seed should be planted and if the grower saves his own seed they should be selected when the vines are harvested and special care taken that they do not heat or otherwise become injured. Only the best seed should be saved from only the best vines.

The time to plant varies with latitude and advent of warm weather. Planting may be done any time after the ground has become warm and forest vegetation is becoming green. A slight frost will seriously injure if not destroy the peanut plant, either in spring or fall, and it is not safe to plant them earlier than cotton or cowpeas are usually planted.

With the larger varieties it is almost invariably the cutsom to shell the seed before planting. The Spanish, however, are not infrequently planted without shelling or after having broken the pods in two. A test made at Newport gave 84.8 per cent of a stand from shelled nuts and 95.1 per cent from nuts only broken in two. (p. 103, Ark. Agr. Exp. Sta. Bul. No. 58.)

A test made at Fayetteville in 1900 gave 98 per cent germination from shelled, 91 per cent from pods broken in two, and 78 percent from whole pods. The plots planted with the whole pods were very slow in sprouting, and some were about five weeks in appearing above the ground. The broken pods did better, but were not so prompt to germinate as were the shelled nuts. An attempt to hull several varieties of peanuts in a cowpea huller was very unsuccessful with the larger Virginia and Tennessee varieties, but gave satisfactory results with the Spanish. About 20 per cent were spit by the pea huller, but their loss was more than compensated for by the time gained. Could some means have been devised for cheaply separating the split from the whole peanut the work would have been quite satisfactory.

DISTANCE TO PLANT.

Peanut rows may be anywhere from two to three and a half feet apart, though three feet is the usual distance. The distance in the drill varies from four inches to two feet according to the variety and nature of the soil. The Virginia and Tennessee varieties are usually given from twelve to eighteen inches in the drill, but the Spanish will give heavier yields planted from four to twelve inches in drills eighteen inches to three feet apart.

On July 19, 1894, three plots were planted on well enriched soil to test very close planting, as compared with ordinary distances. (P. 125, Ark. Ex. Sta. Bul. No. 34.) The distances given and the yields were as follows:

Planted 12x4 inches, 143½ bushels per acre.
Planted 12x12 inches, 102 bushels per acre.
Planted 24x12 inches, 91 bushels per acre.

In 1900 a similar test was made at Fayetteville on soil that had never been fertilized and that produced about 35 bushels of corn per acre the year previous. The results were:

Planted 2 feet by 3 inches, 118 bushels per acre.
Planted 2 feet by 6 inches, 98 bushels per acre.
Planted 2 feet by 12 inches, 90 bushels per acre.
Planted 2½ feet by 3 inches, 123 bushels per acre.
Planted 2½ feet by 6 inches, 96 bushels per acre.
Planted 2½ feet by 12 inches, 91 bushels per acre.

These plots were cultivated three times with cultivator and hoed once. The 1894 tests were cultivated entirely by hand. The close planting not only gave the better yields of nuts, but a greater quantity of hay of apparently better quality than was secured from wider planting. Another test made at Newport further emphasizes the advantage of close planting. This test (p. 101, Ark. Ex. Sta. Bul. No. 58) is given below:

	Yield in bu. 2 ft. rows.	Per acre 3 ft. rows.
4 in. in drill	172	124
6 in. in drill	100	108
8 in. in drill	136	106
12 in. in drill	164	115
18 in. in drill	132	95

Average distance in drill 9.6 inches.

Average yield from 2½ foot rows, 140.8 bushels.

Average yield from 3 foot rows, 109.6 bushels.

From these several tests it may be concluded that Spanish peanuts will give best yields from rows two and a half feet apart with the peanuts from four to twelve inches in the drill.

CULTIVATION.

The object of cultivation is to at all times keep the surface of the soil thoroughly loose, and to suppress all weed growth. The methods of culture usually practiced with corn, cotton, cowpeas and potatoes will answer, and the same implements may be used. If rain has fallen between the time of planting and the germination of the peanuts an iron tooth harrow with slanting teeth may be run over the whole field, or better still, this broadcast cultivation may be done with the weeder. This should be done when the surface soil is just dry enough to crumble nicely and before it has become hard enough to bake. These implements will at this time not only destroy the young weed growth when it is more easily and effectually destroyed, but also leaves the soil in the best physical condition for the promotion of the rapid growth of the young peanut plants. Should the growth of weeds become too large to be destroyed by these implements double shovels or cultivators may be used. Many, however, use the turning plow and "bar off" the rows by running close to the young plant on either side, throwing the soil into the middles, thus covering the weeds. Hoes follow, cleaning the foreign growth from the young plants and loosening the soil around them. Subsequent cultivations are with cultivator and double shovel followed by the hoe, and should be of such frequency as to prevent the growth of weeds and the formation of a soil crust. If the crop preceding the peanuts has been carefully tilled and but few weed seeds allowed to mature the cost of cultivating will be less. The varieties of upright growth are more easily cultivated than those of prostrate habit and the cultivation of the former may be continued longer than those of prostrate habit, and the cultivation of the former may be continued longer without injury to the plant. If the hoe is used before the pods have begun to form great care should be taken lest the young pods be cut off or pulled by the use of the hoe. If the vines of the variety grown are of prostrate habit cultivation with both hoe and plow must cease when the plants have pretty well covered the ground, but those of upright growth may be cultivated as long as the presence of weeds or the condition of the soil may indicate need of cultivation. After the first plowing all subsequent cultivation should be shallow and frequent. If the soil is in good physical condition at the beginning the first plowing need not be more than two inches deep. The practice of covering the blossoms of the peanut with soil is not only no advantage but a direct injury. There is no valid reason justifying such a practice. Experiments conducted for the purpose of determining the effects of covering the vines while in blossom have given decreased yields of more than one fourth as compared with not covering the vines. It is an expensive and tedious operation that not only does no good but is a direct injury.

HARVESTING.

A crop of peanuts grown for market requires more care in harvesting than a crop grown for stock food, since one of the most important features is to cure the pods in perfectly clean and bright condition. The crop should be planted sufficiently early to allow it to mature before frost, since frost will destroy the feeding value of the vines. The first killing frost is not infrequently preceded by rain which interferes with harvesting until damage is done by frost. Usually, however, the crop will have become sufficiently mature by late September or early October for harvesting. These two months are usually dry with an abundance of sunshine, and the necessary care and attention given at the proper time will insure a product of at least good quality.

Harvesting should not be delayed for any great while when the first formed nuts have matured, since these are not infrequently lost by sprouting induced by rain occurring after the nuts have matured. Early planting should be examined at intervals and dug before there is any loss from this cause. It is not necessary, as many suppose, to delay harvesting until a short while before frost, since the operation may be begin at any time when the nuts have become sufficiently mature.

If peanuts are to be grown to any considerable extent for market it will be economical to procure a plow especially constructed for the purpose. Any plow with a long, narrow wing that will reach down and sever the tap root will answer. The plow must run sufficiently deep to pass under the nuts without detaching them from the vines, since the nuts thus severed are lost, or at least must be gathered by hogs. Care should be taken to have no soil thrown on the vines. When the vines have been plowed in the forenoon they are usually gathered together in the afternoon of the same day, three or four rows being thrown together with pitch-forks. The vines are either placed in small cocks or left in a continuous pile for several days, the length of time depending upon weather conditions. If rail falls and the vines remain wet for any length of time, the pods will mildew. To avoid this they should be spread thin after having become wet that the dying may be rapid. Vines heaped or put into cocks while wet with either dew or rain are sure to produce mildewed pods. The same undesirable result will follow should too many vines be bulked together in damp or cloudy weather. When the vines have become partly wilted they are stacked about poles where they remain until the pods have become cured and are ready for picking. These poles are usually about seven feet long and are securely set in the ground at such intervals as the quantity of vines require. In packing the vines about these poles pieces of fence rails, brush, or some such material should be placed on the ground to keep the bottom vines dry and to admit circulation of air through the stack from beneath, a space being left around the pole to facilitate this air circulation. The stacks are not always capped, but should be. Straw, hay, corn, fodder and cotton cloth caps are used for this purpose. Peanuts thus stacked require from fifteen to thirty days to become sufficiently dry for picking, the most tedious and expensive operation in peanut culture. The plan usually followed at the station has been to allow the vines to remain several days in cocks or windrows. At intervals of two days these cocks or windrows, as the case may be, are turned over, exposing the under surface to the drying effects of the sun. When the vines have become thoroughly cured they are hauled to the barn and spread in as thin layers as the barn space will allow, and turned occasionally until thoroughly cured. The nuts may then be picked from the vines at such times as no outdoor work can be performed to advantage. Machines are made that do acceptable picking but the Station has had no experience with them. Formerly the peanuts were cleaned on the farm in a "cleaner" of simple construction and home-made. It consisted of a cylindrical or barrel-shaped box three or four feet long and two feet long and two feet in diameter. Slats are nailed to two circular pieces of board and spaced so as not to allow the peanuts to pass through the inter-slat spaces. An axis runs through the box and transverse pieces are fastened to the ends of this axis as to an old styled well windlass. A door is made into one side of this box for the admission of the peanuts and the windlass or crank in being turned rolls and rubs the nuts together, thus freeing them from dirt that may adhere and to some extent polishing the pods. In the peanut sections there are factories where the process of cleaning and polishing is done by improved machinery.

The yield of peanuts varies from twenty-five bushels to one hundred, and occasionally as high as 150 bushels. The highest yield recorded by the Arkansas Station is 143.5 bushels. This yield was secured from the Spanish variety and on highly fertile soil that had been used for truck garden experiments on the Camden Branch Experiment Station. The highest yields secured at Fayetteville were in 1902, when the Virginia white yielded 113.6 bushels per acre and the Spanish yielded 109.09 bushels per acre on soil of only ordinary fertility, and without fertilization other than the plowing under of the stubble from a heavy crop of cowpeas. This soil was a mixture of calcerous and siliceous formation, admirably suited to the requirements of the peanut plant. Peanuts may be made a profitable crop where such soils occur. In addition to the crop of nuts there is secured under proper management a good yield of hay of value very near equal to clover and alfalfa, pound for pound. The numerous estimates made by the Station as regards the yield of hay from a crop of peanuts varies from one to very near three tons per acre. This hay is usually worth at least $10 per ton and may be considered a by-product when the nuts are harvested for market. When the Spanish variety is grown for the purpose of being grazed by hogs the hay may be mown before the hogs are turned into the field, or it may be grazed by cattle, horses, sheep or goats, and the hogs then given access to the nuts.

PEANUTS IN ROTATION AND AS A CATCH CROP FOR HOGS.

The Spanish peanut on account of its prolificacy and the fact that it will give profitable returns on almost any soil that will grow other crops, has become an important hog feed and is now grown for this purpose to a more or less extent throughout the South. The peanut, cowpea, soy bean, chufa, artichokes, potatoes, alfalfa, clovers, wheat, oats and rye grown especially for the purpose of being harvested by hogs, will, under proper management, enable the Southern farmer to maintain his hogs in good condition at least ten months in the year without other feed.

Spanish peanuts intended for grazing by hogs may be planted at any time after danger of frost is over on to the first or middle of July in north Arkansas, and as late as the middle of August in the southern part of the state. The time and methods of planting this variety of peanuts for hog feed is quite adjustable and the crop may be associated with almost any system of cropping practiced in the South. The most profitable practices with this variety consist in growing the peanuts with some other crop, as corn, or after some crop has been harvested. When grains, Irish potatoes, crimson clover, and such crops that are harvested in May and June have been taken off, the same fields may be seeded to peanuts. They may be planted in missing places in the cotton and corn fields, between the hills of corn in the rows, or in the middle, as is frequently the custom with cowpeas. In fact, any unoccupied areas so situated that hogs may be given access to them may be devoted to peanuts at little cost and increased profits. In young orchards peanuts may be grown near the trees without injury from the vine climbing upon them, as would be the case with velvet beans and cowpeas planted near the trees.

USES.

The principal use of the peanut at present is as roasted peanuts. They are sold throughout the country parched or roasted in the hulls, and shelled as salted peanuts, and ''burnt almonds.'' They are used for peanut candy and chocolates. In Europe one of the principal uses of the peanut is for the production of oil, of which they contain from

40 to 50 per cent. This oil is equal in every respect to olive oil, for which it is a perfect substitute. The oil is extensively used in the manufacture of soap, and as a lubricant for machinery. The peanut oil cake or meal is valuable for feeding stock and is worth from $25 to $30 per ton, and contains about 50 per cent protein. Peanut meal is used to some extent as a food for man, and in Germany has been experimented with to at least a partially successful extent as an army ration.

This Station has fed the whole peanut plant to horses and mules doing ordinary farm work. The animals did as well on this ration alone as they did before and after on the ordinary rations of corn and hay, and in the summer the advantage seemed to be decidedly in favor of the peanut. Only the Spanish variety was fed, and after the first few days in such quantity as the appetite of the animals demanded.

Parched peanuts make an excellent substitute for coffee, and is far more nutritious. When so used it may be parched, ground, and the beverage prepared as in coffee. Mixed half and half with coffee it it difficult to detect the difference between the mixture and pure coffee.

Peanut bread is sometimes made from the meal and is of high nutritive value.

Cotton Food-Products In Hog Feeding.

By R. R. Dinwiddie.

A first report of my experiments in feeding cotton seed meal to hogs is contained in Bul. No. 76 (Ark.), published 1903. Since then other feeding trials have been made with cotton seed meal, chopped cotton seed, cotton oil, and cotton hull bran with the object, mainly, of learning something more of the toxic or poisonous effects of these foods on hogs, the maximum safe allowance at different stages of growth, and of their utility or otherwise in pork production under any circumstances.

In explanation of the rations used in the later of these experiments, I should state first my ideas of the possible use of cotton seed meal as a profitable pig feed. At $1.25 per hundred, which is its least cost laid down here in half-ton quantities, cotton seed meal as a large constituent of any ration cannot be called a cheap feed. As an exclusive feed, if it could be used that way, it is more expensive than corn. Corn itself makes a one-sided or badly balanced ration for pigs or any other kind of young stock. When fed alone to pigs it results in stunted growth, unthrift and disease, a fact which is well known to all observant and careful feeders but too little appreciated by the general run of farmers. This is due to its high content of those elements of the food which develop fat and heat and lack of those necessary for the development of flesh and blood upon which the proper growth of the animal depends. Cotton seed meal, on the contrary, contains a great excess of these latter elements and a deficiency of those starchy constituents which are so much in excess in corn. Independent of any actual poison present in cotton seed meal its exclusive or excessive use in hog feeding would doubtless also result in unthrift and disease. But it supplies the nitrogenous or flesh-forming elements in the cheapest concentrated form in which it can be bought. For these reasons cotton seed meal and corn should supplement each other and be fed together. We arrive at this conclusion by theoretical reasoning, and it remains for practical experience to confirm or refute the theory. Therefore in the later of the following trials with cotton seed meal, corn formed the basis of the ration, cotton meal being added only in quantity approximately to supply the protein or nitrogenous constituents lacking in corn, or in other words, to "balance the ration." Wheat bran in small amount, where used, was for the purpose of adding bulk to the food and increasing its palatability. Cotton seed meal and corn meal, or chops, are both of them highly concentrated, heavy foods, too much so for growing pigs which require something additional to supply bulk. In the proper raising of pigs this should be supplied by grazing crops which, indeed, should form a constituent of the ration in all stages of hog feeding except, perhaps, the final fattening. Our experiments were made in pens and did not include grazing or green food of any kind, and hence are not tests of the economical raising of pigs, their object being rather to determine the degree of tolerance of the animals to the various cotton foods employed, so that a guide might be obtained for future tests of an economic character.

The animals used were Tamworths, full blood, or Poland China crossed, bred and raised on the college farm. They were fed and watered twice a day and had access to a mixture of salt and hard wood ashes kept in boxes under cover.

Several of these feeding trials are continuations or extensions of those described in Bul. No. 76; that is, after the first trial was completed the combination of the ration was changed and the feeding continued with the same animals. In such cases a brief summary only of the earlier test is given here.

From the first series of feeding tests (recorded in Bul. 76), it was learned that to pigs from 50 to 100 pounds in weight, cotton seed meal could not safely be fed in amount exceeding one-half pound per day, but that one-third of a pound properly combined with other concentrated foods—bran, shorts, corn or wheat chops—occasioned no obviously harmful effects. However, the number of tests and animals employed were insufficient to justify us in making a positive statement of the safety of even this amount. Accordingly these experiments were continued, the rations being modified in various ways, until a considerable experience on this matter has now been obtained.

The additional trials here reported are fourteen in number and include forty-one animals. Some of the data of these experiments being unimportant from our present standpoint are omitted from the report but can be worked out by any one interested, these being especially the weights of the food other than cotton seed meal.

The first seven experiments are feeding trials in which cotton seed meal is fed in conjunction with wheat bran, corn or chopped wheat in proportions larger than would be generally safe unless the total allowance of concentrated food daily was somewhat reduced, a system which may be the best where good pasturage is available. We learn from these the maximum safe feeding of cotton seed meal at various stages of growth.

Our experiments were made with Tamworths, or their grades, a late maturing lean kind of hog, employed by us, not from choice, but on account of their availability. Variations of susceptibility to cotton seed meal poisoning on account of breed is a matter about which no assertion can be made with our present knowledge.

I. COTTON SEED MEAL, WHEAT BRAN, COW PEA HAY.

Animals.—Three pigs averaging in weight 70 to 80 pounds.

[Previously fed a mixture of cotton seed meal 1, wheat bran 3, for 95 days, the total weight of cotton seed meal consumed each being 54 pounds and daily allowance .5 pounds. The animals remained in health and experiment closed Nov. 27, 1902. (See Bul. 76, page 139.)]

To determine the limit of tolerance of this highly nitrogenous mixture the test was continued as follows:

1902. Nov. 27 to Jan. 1, 1903—34 days.

Ration: Cotton seed meal 1, bran 3, cow pea hay about 1 pound per day.

Total consumption cotton seed meal, each, 33.3 pounds.

Daily consumption cotton seed meal, each, 1 pound.

No sickness observed; growth moderate; appetite good.

1903. Jan. 1 to Feb. 2—32 days.

Ration: Cotton seed meal 1, bran 4, cow pea hay.

(Object of change: To increase allowance without increasing cotton seed meal.)

Total consumption cotton seed meal, each, 30 pounds.

Daily consumption cotton seed meal, each, 1 pound.

One of the three pigs showed the effects of this large allowance of cotton seed meal. Jan. 20th it refused food, appeared dull and showed the "thumps" or jerking respiration common in acute cotton seed meal poisoning. After a day or two it returned to feed for two or three days then again showed the same symptoms for a few days. Evidently the limit of cotton seed meal tolerance had been surpassed. The other two pigs showed no indisposition but their growth was not an equivalent of the food consumed.

1903. Feb. 2 to April 1—57 days.
Ration: Cotton seed meal 1, bran 4, corn (in ear) 5.
(Object: To widen the ration preliminary to fattening.)
Total amount cotton seed meal consumed, each, 32 pounds.
Daily cotton seed meal consumed, each, .6 pounds.

On this diet all remained thrifty and made a good growth.

April 1, 1903, to May 14—44 days.
Ration: Ear corn to limit of appetite.
May 14 they were sold for slaughter in fair condition.
Total weight of hogs, 765 pounds.
Average weight of each, 255 pounds.

Summary of whole feeding test:
Total consumption of cotton seed meal, each, 96 pounds.
(Including test previously reported, each, 150 pounds.)
Gain in weight, each, during test (166 days), 175 pounds.
Daily gain, each, 1 pound.
Total food consumed (excluding cow pea hay), each, 1029 pounds.
Weight of food per pound gain, 5.9 pounds.

Remarks: The mixture fed in the first period of this experiment, cotton seed meal and wheat bran in proportion 1 to 3 and 1 to 4, is not one that could be selected for economical feeding as it forms an extremely nitrogenous ration. The experiment demonstrates the wide range of digestive capability of the hog—thriving fairly well for half a year or so on a ration with a nutritive ratio as close as 1:2.5 in this instance, or on an almost exclusive corn ration (N. R. 1:10) as is customary on many farms. It demonstrates also the increased tolerance to cotton seed meal acquired by habit.

II. COTTON SEED MEAL, WHEAT BRAN, CORN CHOPS.

Animals.—Three pigs, averaging in weight about 90 pounds.

[Previously fed for 95 days a mixture of cotton seed meal 1 to wheat bran 3, the total weight of cotton seed meal consumed each being 54 pounds and daily allowance .5 pounds. Animals remained in health and experiment closed Nov. 27, 1902. (See Bul. 76, page 139.)]

The experiment was continued on a wider ration and with a larger allowance of cotton seed meal, as follows:

1902. Nov. 27 to Dec. 31—34 days.
Ration: Cotton seed meal 1, wheat bran 1, corn chops 2. (N. R. 1:3.7.)
Total cotton seed meal eaten, each, 25 pounds.
Daily cotton seed meal, each, .7 pounds.

1903. Jan. 1 to Mar. 12—70 days.

Ration: Cotton seed meal 1, wheat bran 1, corn chops 3. (N. R. 1:4.3.)

Total cotton seed meal eaten, each, in this period, 54 pounds.

Daily cotton seed meal eaten, each, in this period, .7 pounds.

Pigs remained in good health and made a fair growth.

1903. Mar. 12 to April 1—19 days.

Ration: Cotton seed meal 1, wheat bran 1, corn chops 4. (N. R. 1:5.)

Total cotton seed meal consumed, each, in period, 14 pounds.

Daily cotton seed meal consumed, each, in period, .7 pounds.

On Mar. 14th one of the three animals refused food but only for one day. They were now in about "half fat" condition.

1903. April 1 to May 4—34 days.

Ration: Ear corn to limit of appetite.

The hogs were sold and butchered in fair condition on May 14. Total weight, 745 pounds, equal to an average of 248 pounds each. *Some further data of the whole experiment:*

Period of continuous feeding cotton seed meal in this test, 123 days.

Cotton seed meal consumed in this time, each, 94 pounds.

Average daily consumption cotton seed meal, each, .7 pounds.

Average daily gain during period, 1 pound.

Food consumed (omitting cow pea hay, of which an insignificant amount was eaten), per pound gain, 4.5 pounds.

Including the previous test, of which this was a continuation, cotton seed meal was fed daily without intermission for seven months, the total consumption, each, being 148 pounds, and the average daily allowance, approximately, two-thirds of a pound.

III. COTTON SEED MEAL AND CORN CHOPS.

In this test a mixture of cotton seed meal and corn chops was fed in an amount which it was expected would produce fatal poisoning. In tests of previous year it was found that a daily allowance of .6 pounds cotton seed meal in mixture with corn chops, in proportion 1 to 3, when fed to fifty-pound pigs, proved fatal within six weeks. This lot of pigs, however, took .8 pounds daily each without symptoms of poisoning, but the pigs were larger than in previous year and the proportion 1 to 4 instead of 1 to 3.

The experimental animals consisted of three Tamworth-Poland China crossed pigs, averaging in weight 85 pounds.

1903. Jan. 1 to Mar. 12—70 days.

Ration: Cotton seed meal 1, corn chops 4. (N. R. 1:5.)

Total cotton seed meal consumed in this period, each, 60 pounds.
Daily cotton seed meal consumed in this period, each, .8 pounds.

Mar. 12 to June 6—86 days.
Ration: Cotton seed meal 1, corn chops 5. (N. R. 1:5.6.)
Total cotton seed meal eaten in period, each, 73 pounds.
Daily cotton seed meal eaten in period, each, .8 pounds.

No sickness was observed. One animal during this period farrowed and suckled a litter of six pigs which, apparently, suffered no harm on account of the heavy cotton meal diet of the dam.

Data of the whole experiment:

Length of continuous feeding cotton seed meal, 156 days.
Total amount consumed, each, 133 pounds.
Daily amount consumed, each, .8 pounds.

For two of the pigs there is the following further data:

Average weight of pigs when sold, June 6, 262 pounds.
Daily gain in weight during experiment, 1.1 pounds.

Weight food consumed, per pound gain, approximately, 4 pounds. (Assuming that these two pigs ate two-thirds of the whole food allowed.)

IV. COTTON SEED MEAL, BRAN, CORN, CUT COW PEA HAY.

This was an attempt to substitute finely cut cow pea hay (vines and peas) for part of the bran and corn chops.

Animals.—Three pigs averaging in weight 70 pounds each.

1903. Jan. 1 to Mar. 12—70 days.

Ration: Cotton seed meal 1, bran 1, corn chops 2, cut cow pea hay 1. (N. R. 1:3.7.)

Total cotton seed meal eaten, each, in this period, 52 pounds.
Daily cotton seed meal eaten, each, in this period, .7 pounds.

The cut hay and meal were wet and well mixed together. The pigs remained in good health and made a fair growth but made little use of the cut hay, much of it being thrown out of the trough and wasted in the effort to avoid eating it. It was cut in quarter-inch lengths and in this shape did not make a satisfactory mixture with the meal for pig feed.

Mar. 12 to June 22—103 days.
Ration: Cotton seed meal 1, bran 1, ear corn 7.
Total cotton seed meal eaten, each, in this period, 48 pounds.
Daily cotton seed meal eaten, each, in this period, .4 pounds.

For whole experiment:

Cotton seed meal consumed, each, 101 pounds.
Cotton seed meal consumed, daily, each, .5 pounds.

Average weight at conclusion of test, each, 211 pounds.
Weight feed (omitting hay) to each pound gain, 5 pounds.

V. COTTON SEED MEAL, WHEAT CHOPS, CUT COW PEA HAY.

Animals.—Two red pigs, average weight 95 pounds.

(This is a continuation of a previous test in which cotton seed meal and wheat chops were fed alone in proportion 1 to 3 for 99 days, the total consumption of cotton seed meal, each, being 57 pounds, and daily consumption, each, being .5 pounds; no sickness. See Bul. No. 76.) It was sought to increase the bulk of the ration and test the availability of cut cow pea hay for this purpose.

1902. Nov. 27 to Jan. 1—34 days.
Ration: Cotton seed meal 1, wheat chops 3, cut cow pea hay 2.
Total consumption cotton seed meal, each, 25 pounds.
Daily consumption cotton seed meal, each, .7 pounds.

Pigs showed no sickness. Cut hay was not eaten well and in this shape was not satisfactory. The quantity was, therefore, reduced.

1903. Jan. 1 to Mar. 12—70 days.
Ration: Cotton seed meal 1, wheat chops 3, cut cow pea hay 1. (N. R. 1:3.)
Total consumption cotton seed meal in this period, each, 74 pounds.
Daily consumption cotton seed meal in this period, each, 1 pound.

No sickness; growth fair. Cut hay was seen to be unsuitable for supplying bulk and seemed to add nothing profitable to the ration. The experiment was concluded with a new ration as under.

1903. Mar. 12 to June 2—82 days.
Ration: Cotton seed meal 1, bran 2, ear corn 6. (N. R. 1:5.7.)

For convenience in feeding the meal mixture was fed in morning, the corn at night.

Total cotton seed meal eaten in this period, each, 45 pounds.
Daily cotton seed meal eaten in this period, each, .5 pounds.

These two hogs made a satisfactory growth and were sold in fair butchering condition June 2d. Average weight, each, 267 pounds.

The whole feeding test, lasting 186 days, supplies the following data:

Total consumption cotton seed meal, each, 144 pounds.
Average daily consumption cotton seed meal, each, .8 pounds.
Average daily gain, each, .9 pounds.

Feed (omitting hay and deducting 20% from weight of ear corn), per pound gain, 4.3 pounds.

The large daily allowance of cotton seed meal during the first two periods was probably tolerated on account of a "habit immunity" acquired during the previous feeding test.

VI. COTTON SEED MEAL AND WHEAT CHOPS.

This like the last is a continuation of a previous test of the same ration (recorded in Bul. No. 76). It differs from experiment V only in the absence of cut hay in the mixture and it shows the limit to which cotton seed meal can be pushed in such a concentrated ration.

As in all the other feeding trials cow pea hay (including pods) was supplied to the extent of about 1 pound each daily in racks to which all had access. The peas only were eaten, the vines and leaves being dragged out and trampled under foot.

Animals.—Two Tamworth-Poland China crosses averaging each 100 pounds; about alike in size. They were previously fed cotton seed meal continuously for 99 days, each consuming daily .5 pounds, and, in total, each, 57 pounds. No sickness developed. The daily growth was small on account of limited allowance. This trial closed Nov. 27, 1902, and the next started without intermission.

1902. Nov. 27 to Jan. 1—34 days.

Ration: Cotton seed meal 1, wheat chops 3. (N. R. 1:2.9.)
Total cotton seed meal eaten in period, each, 35 pounds.
Daily cotton seed meal eaten in period, each, 1 pound.

Health and appetite good and growth satisfactory. This mixture makes a ration too heavy and concentrated, the nutritive ratio too close, and the proportion of cotton seed meal too high to admit of a sufficient allowance.

1903. Jan. 1 to Mar. 9—68 days.

Ration: Cotton seed meal 1, wheat bran 1, wheat chops 3. (N. R. 1:3.)

Total cotton seed meal eaten in this period, each, 60 pounds.
Daily cotton seed meal eaten in this period, each, .9 pounds.

Both pigs did well till about March 1st when one began to lose appetite. On March 9th both refused food completely and showed by their rapid and "thumping" respiration that they were suffering from acute cotton seed meal poisoning, which, as was shown in a previous report, manifests itself in this way. The cotton seed meal was stopped and bran and corn only allowed, but for a week neither of them cared to eat much, and for the next month did little good. On April 1st they were put on an exclusive corn ration which was continued till May 20 when they were sold in fair butchering condition.

For whole experiment up to beginning of sickness and including the previous test in which the ration was the same in kind, the following summary may be made:

Time of continuous feeding cotton seed meal, 201 days.
Total cotton seed meal eaten, each, 152 pounds.
Average daily cotton seed meal eaten, each, .7 pounds.

Toxic effects were exhibited after 102 days feeding at the rate of nearly 1 pound per day, the average weight of the animals at this time being about 160 pounds. In spite of the set back they received these pigs, for the whole experiment from Jan. 1 to May 20, 152 days, made an average gain of 1 pound per day, weighing at the close, collectively, 500 pounds.

VII. COTTON SEED MEAL, BRAN, CORN.

Animals.—Two small pigs, weighing respectively 25 and 33 pounds, both of them something on the "runt" order, were fed on the following ration with the purpose of inducing fatal poisoning and comparing the postmortem lesions with those found in earlier reported tests. They were poor eaters, however, and neither of them showed any typical symptoms. One of them ultimately made a fair butchering hog; the other, after a struggling existence, died in 107 days without any marked symptoms or lesions of cotton poisoning.

1903. Aug. 19 to Dec. 4—107 days.
Ration: Cotton seed meal 1, bran 1, corn chops 3.
Total cotton seed meal eaten, each (average), 56 pounds.
Daily cotton seed meal eaten, each (average), .5 pounds.

The same mixture was continued with the remaining pig for 78 days longer then stopped and the animal sold to the butcher. This latter pig altogether consumed, of cotton seed meal, 146 pounds in 185 days; daily, .7 pounds; gained, per day, .8 pounds, and weighed at close 188.

VIII. COTTON SEED MEAL, BRAN AND CORN.

In this experiment it was sought to learn the economical value of cotton seed meal in a mixed grain ration for pigs by adding it to a corn diet only in amount sufficient to supply the deficiency of protein in the latter. This is proceeding on the assumption that corn is really the cheapest grain feed that can be raised throughout the greater part of this country and the basis of our cheap pork production, as compared with other countries. Bran (which, as obtained locally, approaches the composition of shorts or middlings), was added in proportion necessary to give bulk and palatability to the meal ration since it was desired to feed the corn in the customary convenient way, namely, in the ear. Later, in order to feed the ear corn all at one time, part of the corn was fed in the form of chops in mixture with the cotton seed meal and bran for the morning meal, while the ear corn was fed alone at night, but the proportion of corn to the other ingredients was the same throughout.

Animals.—Three Tamworth pigs, weighing 67, 69 and 89 pounds. Average weight, 75 pounds each.

1903. Aug. 19 to Sept. 18—30 days.

Ration: Cotton seed meal 1, wheat bran 1, ear corn 6.

Sept. 18. Ration: Cotton seed meal 1, wheat bran 1, corn chops 2, ear corn 4. Meal mixture fed A. M., corn, P. M. Allowance about what they would eat up clean.

Summary (averaged for each pig) of whole experiment, lasting 181 days:

Total cotton seed meal eaten, 92 pounds.
Daily cotton seed meal eaten, .5 pounds.
Weight at beginning of trial, 75 pounds.
Weight at close, 226 pounds.
Total gain, 151 pounds.
Daily gain, .8 pounds.
Total food consumed, 626 pounds.
Food consumed for each pound gained, 4.3 pounds.

There was no evident sickness or impairment of appetite and the hogs, at the close, were in good butchering condition for this breed.

IX. BRAN AND CORN CHOPS.

This was designed as a check on the cotton seed meal feeding tests generally and especially for comparison with the preceding (experiment VIII), with which it was simultaneously carried on.

Animals.—Three pigs, averaging 70 pounds, were fed bran (or shorts) in the morning and ear corn at night, both to full extent of appetite, the proportion (2 to 1) being, however, maintained.

1903. Aug. 19 to Feb. 22, 1904—188 days.

Ration: Wheat bran 2, ear corn 1.

One pig was temporarily "off feed" from Nov. 8 to 12th, and in that time lost weight considerably.

Summary of feeding test (averaged for one animal):

Total food eaten (corn as shelled), 672 pounds.
Weight at start, 70 pounds.
Weight at close, 189 pounds.
Total gain in weight, 119 pounds.
Daily gain, .6 pounds.
Food eaten per pound gain, 5.6 pounds.

X. CHOPPED COTTON SEED, BRAN AND CORN.

Omitting problematical changes occurring in the process of separating the oil, cotton seed as a food differs from the meal in containing or including the hulls and the adherent cotton (46 per cent), the expressible crude oil (14 per cent), the cake or meal representing the remainder (40 per cent).

In this and the next feeding test cotton seed roughly chopped was fed in such amount that the daily allowance to each animal would not contain more than about half a pound of cotton seed meal, the hulls and the excess of oil being, of course, additional.

Three objects were under observation in this experiment, namely, (1) the toxicity of the cotton seed as compared with the meal; (2) the effects of cotton food products on breeding sows carrying young, and (3) the suitability of cotton seed in a mixed ration for hogs.

Animals.—Two adult sows, one a Tamworth and the other a grade Poland China both recently bred. The black sow had previously been fed (during preceding pregnancy) with cotton seed meal 1.4 pounds per day for 80 days without showing symptoms of poisoning. An interval of two months elapsed between this and the present test.

1903. Jan. 1 to Mar. 12—70 days.
Ration: Cotton seed 1, bran 2, ear corn 3.

The cotton seed was fed alone and the bran and corn in the evening, thus insuring a hungry appetite in the morning. The cotton seed, however, was not well eaten throughout the test, the hulls and lint being rejected as much as possible. The amount they could be induced to eat was less than one pound each per day. On March 14th, or 72 days from beginning of test, the Poland China sow sickened and died on the 21st.*

Mar. 12 to April 7—26 days.
Ration: Cotton seed 1, corn 3.

On this diet the remaining sow was continued. She farrowed March 31st (114 days from breeding) a litter of seven pigs, all living and healthy looking and of usual size. On April 7th the experiment with cotton seed was closed and the ration changed.

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*The symptoms were dullness, complete refusal of food and difficult respiration. It was also observed to pass urine thick and yellow like oil. On dissection the principle lesions found were briefly as follows: Hydrothorax in large degree, considerable peritoneal effusion, extreme engorgement of liver, and less so of spleen, hyperemic patches in lung. In the kidneys there was marked organic change. The right was rough and pitted on surface, the capsule adherent, and the substance sclerotic. The left was replaced by large cysts with fibrous walls and showed on section only a few small areas of true kidney tissue remaining. The urine was cloudy, acid, offensive in odor and highly albuminous. The sediment showed numerous cells, globular, pear-shaped and fusiform, all large and with vesicular nuclei. No tube casts. The sow was found not pregnant.

April 7th to July 11—94 days.

Ration: Cotton seed meal 1, bran 2, ear corn 6.

On this ration, which is nearly the same as in experiment VIII, and contains about the right proportions of the various nutriments, both sow and pigs did well and the sow was sold for pork in fair condition, weighing 270 pounds.

Summary of this test (Black sow):

(Previously fed 111 pounds cotton seed meal in 80 days; two months interval.)

Days fed cotton seed, 70.
Total amount fed, 55 pounds.
Daily amount fed, .8 pounds.

For red sow the figures are:

Days fed cotton seed, 96.
Total amount cotton seed, 81 pounds.
Daily amount cotton seed, .8 pounds.
Days fed cotton seed meal, 94.
Total amount cotton seed meal fed, 75 pounds.
Daily amount cotton seed meal fed, .8 pounds.

XI. CHOPPED COTTON SEED, BRAN AND CORN.

The objects sought for here were in part similar to those of the test just preceding, that is, to learn something of the toxicity of cotton seed for hogs, and of its availability as a constituent in a mixed hog ration.

The cotton seed was roughly chopped and contained considerable adherent cotton. As in the preceding test it was not well eaten. For the first week it was almost entirely refused. Several changes were made in the ration during this test. Starting out with a ration of cotton seed and corn alone it was found after a few days that the animals were depending almost entirely on the corn. Bran was then substituted for part of the corn and both of these fed at night, the cotton seed in the morning. In the last part of the experiment, when they had gotten to eating the cotton seed more freely, corn and cotton seed again formed the complete ration, the bran being omitted.

Animals.—Four pure blood or cross-bred Tamworth pigs, averaging in weight 80 pounds each and of uncertain age, but supposed to be about six months, were taken from the woods where they had been on scant allowance and put in a twenty by thirty foot pen with an open sided shed for overhead shelter. In addition to the ration described a handful or two of uncut cow pea hay was given daily.

1903. Jan. 1 to Feb. 2—33 days.

Ration: Chopped cotton seed 1, wheat bran 2, ear corn 2.

Allowance of cotton seed per day to be half a pound.

Feb. 3 to Mar. 12—37 days.
Ration: Chopped cotton seed 1, wheat bran 1, ear corn 2.
Allowance of cotton seed, three-fourths of a pound each per day.
Mar. 12 to May 26—75 days.
Ration: Chopped cotton seed 1, ear corn 2.
Allowance cotton seed to be one pound each per day.
May 26 to July 2—37 days.
Ration: Chopped cotton seed 1, ear corn 4.
Allowance cotton seed, one pound each per day.

About the middle of the feeding test one pig became lame in the hind limbs, without evident cause, and remained in this condition till near the close. During this time it made little growth, and when butchered weighed considerably less than the others. All were in fair butchering condition when sold, July 2, 1903. Total weight, 860 pounds; average for each, 215 pounds.

Summary of whole feeding test (averaged for one animal):

Total number of days fed, 182.
Number days fed cotton seed, 182.
Average allowance cotton seed per day, .8 pounds.
Total allowance of cotton seed, 158 pounds.
Total allowance of bran, 66 pounds.
Total allowance of ear corn, 417 pounds.
Same reduced to shelled corn, 333 pounds.
Same in bushels, 6.
Allowance cow pea hay, 71 pounds.
Live weight at start, 80 pounds.
Live weight at close, 215 pounds.
Gain during feeding period, 135 pounds.
Gain per day, .74 pounds.
Feed eaten per pound gain, 4.3 pounds.

Of this feeding trial it may be said here that the cotton seed was eaten at first reluctantly and with considerable waste, but later this was less noticeable. The hulls and lint were avoided as much as possible. No indisposition further than that above noted was observed.

The death which occurred in the preceding trial I am inclined to attribute to organic changes effected during the earlier excessive feeding with cotton seed meal.

XII. COTTON SEED MEAL, WHEAT BRAN, CORN CHOPS AND COTTON HULL BRAN.

Cotton hulls, as is well known, are extensively used at or near the oil mills as a cattle feed, in combination with cotton seed meal. For fattening cattle this seems to be an economical ration, the hulls supplying in whole or part the roughage or bulky part of the diet. Hull bran, or "cotton seed bran," consists of cotton seed hulls ground up more or less finely. It should, therefore, contain the amount and proportion of nutrients present in the hulls. Two samples of this material of different degrees of fineness were obtained from Edwin Lehman Johnson who has interested himself especially in cotton food products. The coarser variety was selected for our pig feeding test, and through the intermediation of Mr. Johnson a sufficient supply purchased from a Memphis Cotton Oil Co. Following the practice adopted in all these experiments the cotton food products were not used alone, but in combination with the more common pig feeds—corn and bran. These latter were fed in small amount in order that the hull bran might receive the better test in regard to its possible toxic effects and its value as a pig feed.

The animals employed were three Tamworth pigs weighing respectively 62, 68 and 74 pounds. Average weight, 68 pounds.

1904. April 18 to June 18—60 days.

Ration: Cotton seed meal 1, wheat bran 1, corn chops 1, cotton hull bran 5.

Of this mixture, wet, the pigs were fed twice a day all they would eat up clean. For the first day or two they did not seem to relish it but after that it was eaten readily enough. No unusual symptoms of any kind were manifested during this first period of two months. The average of the dry mixture eaten per day each was three and one-half pounds.

June 18 to Aug. 18—60 days.

Ration: Cotton hull bran increased to six parts. Other ingredients remaining as before.

During this last period the average amount eaten per day each was 4 pounds of the dry mixture; this being all they cared to eat. The pigs remained in health and appeared to retain their appetite, but made a slow growth, as shown by the scales at the end of the feeding trial.

Summary of whole experiment (averaged for one animal):

Number days fed, 120.
Total cotton seed meal fed, 52 pounds.
Total cotton seed meal fed daily, .4 pounds.
Total hull bran fed, 293 pounds.
Hull bran fed daily, 2.4 pounds.
Total gain in weight, 49 pounds.
Daily gain, .4 pounds.

At the close these pigs averaged in weight 117 pounds (101, 121, 129), and were put on corn to fit them for butchering. At the end of 70 days more they were sold with an average weight of 180 pounds, having gained on corn at the rate of .9 pounds per day each.

The above data requires no close analysis in order to show the two main facts: (1) That the assumed toxin of cotton seed meal is not present in toxic amount in the hulls, and (2) that "cotton seed bran" has little if any value in a ration for hogs.*

XIII. CRUDE COTTON SEED OIL, BRAN AND CORN. (Second test.)

Both cotton seed and cotton seed meal contain a much larger proportion of oil than is found in any other stock feeds in common use, the average being for whole cotton seed, 20 per cent, and for meal, about 15 per cent. When cotton seed is fed to hogs the proportion of oil in the food actually consumed is larger than this since a considerable proportion of the hulls, containing but little oil, is refused. Ground linseed cake, or "oil meal," contains not over 8 per cent. Gluten meal, however, may contain 10 to 20 per cent, and peanuts as high as 40 per cent "ether extract."†

In the absence of any demonstration and isolation of a toxic principle sufficiently active and in sufficient amount to satisfactorily account for the harmful action of cotton seed meal when liberally fed to animals it is natural to think of its richness both in protein and oil as a possible cause, absorption of nutrients proceeding in excess of the capability of assimilation and elimination. Excess of nitrogenous constituents is counteracted by feeding with corn in proper proportions (and the proportion for this purpose should not be less than one to five), but the excess of oil or fat in the ration is not counteracted to the same extent.

Experiments in feeding highly oleaginous rations to pigs, made in Denmark, showed no superiority of such over the ordinary foods used in that country—rye and barley—but at the same time no effects harmful to health are reported.‡

By feeding crude cotton seed oil as an addition to a bran and corn ration, we have attempted to learn whether the special symptoms of cotton seed meal poisoning, as previously observed, could be attributed to the oil present in the meal either as containing the assumed toxin or merely on account of its excessive amount in the ration. Such was reported in Bul. No. 76. Since then two further tests of the same kind have been made.

Animals.—The animals used in this second test consisted of four Tamworth pigs weighing 35, 35, 43 and 49 pounds. Average weight, 40 pounds each. They appeared to be a fairly thrifty lot of pigs though not large for their age.

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*At the price at which it is sold, $12 per ton F. O. B. at Memphis, it is not likely to be much sought after by stock feeders but may be highly profitable to oil mill companies and dealers as an adulterant to cotton seed meal.

†References: The Cotton Plant, U. S. Dept. Agri.; Feeds and Feeding; Henry.

‡Feeds and Feeding; Henry, Page 588.

The following statement shows in brief the essential features of this test. Bran was fed in morning after being wet and mixed with the stated amount of cotton oil. Ear corn was fed in the evening, both bran and corn being allowed *ad libitum* but in equal proportion by weight.

1903. Aug. 19 to Sept. 19—30 days.
Ration: Bran 1, ear corn 1, cotton oil 3 ounces, each, per day.
Sept. 19 to Nov 1—41 days.
Oil increased to 4 ounces, each, per day.
Nov. 1 to Nov. 28—27 days.
Oil increased to 5½ ounces, each, per day.
Nov. 30 to Mar. 13—104 days.
Oil stopped; fed on corn and bran alone.

Summary of results:

Number of days fed cotton seed oil, 98.

Amount of oil fed, each, 25 pounds.

Daily amount fed, each, .25 pounds, or 4 ounces.

Daily equivalent in cotton seed meal, oil content, 14 per cent, 1.8 pounds.

Average daily gain, each, during the whole period (202 days), till disposed of, .5 pounds.

As to the effects on the health of the animals: None died; none showed any symptoms such as we had previously observed in cotton seed meal poisoning; one became unthrifty, ate but little food, either bran or corn, and its growth came to a standstill; the others had small appetite and made only a small growth, both while the oil was being fed and later. The smallest animal was killed for dissection but revealed no marked organic changes. Two which ultimately got to butchering condition showed no abnormal condition of viscera except areas of fatty degeneration in the liver, not a very unusual condition in fatted hogs. The fourth was not examined post-mortem.

XIV. COTTON OIL, BRAN AND CORN. (Third test.)

This test was about the same as the preceding but was made with a lot of five culled pigs for which we had no other use. One of these was obviously sick at the start with "thumps," and two others in a condition of unthrift which seemed to be chronic. The other two were apparently healthy. About all that was expected of this test was the possibility of inducing the symptoms of cotton seed meal poisoning by liberal feeding with oil. The ration consisted of wheat bran 2 pounds, cotton meal 1 pound, and crude cotton oil 3 ounces to each per day. The animals were kept in a large wood range.

1904. April 18 to Aug. 26—120 days.
Daily amount cotton oil to each pig, 3 ounces.

Total amount of cotton oil to each of two surviving pigs, 360 ounces.

Results: Two animals died after about one month, another three weeks later, and a fourth on Sept. 24, about one month after the oil diet had been stopped. The fifth survived and finally was sold for butchering after "eating its head off" for several months on a corn ration. Of the four animals that died none showed the symptoms or after-death lesions of acute cotton meal poisoning. Three were dissected, one of which was found to have pneumonia (associated with the swine plague bacillus) in an advanced stage sufficient to account for death; another showed the same trouble in a less degree, while the third seemed to be free from any marked changes.

REVIEW OF EXPERIMENTS.

The information to be derived from these experiments, the details of which have been given above, may be considered from the two standpoints already mentioned, (1) the toxic action of cotton food products on hogs, and (2) their utility or otherwise in pork production.

Toxicity.—Cotton seed meal of good quality, when fed beyond a certain limit, has been found harmful to health in all species of farm animals. Nevertheless, in suitable doses, which experience has determined, it is profitably used in cattle feeding, in fattening steers at or in the vicinity of the oil mills in the south, and as a component in rations for dairy cows every where throughout the country. Evidently the toxicity for these animals is a question of dosage, a suitable allowance forming a harmless and profitable food, while an undue allowance acts as a more or less virulent poison and is, therefore, in the highest degree unprofitable.

It might be supposed that the same statement of the case would apply to hogs, but this is not the prevalent belief. Feeding experiments with cotton seed and meal have, in general, led to so many fatalities in hogs that these feeding stuffs in any quantity are usually regarded as unsafe and unprofitable as a food for pigs at any stage of growth. In my previous report it was pointed out that many of the experiments on which this opinion was based were open to criticism on account of the large quantity of cotton seed meal fed as compared with similar feeding tests with cattle assuming the susceptibility to a toxin to vary inversely as the weight of the animal. Some experimenters, however, have found that even minute doses of cotton seed meal have proved either fatal or harmful in their effects. I have not had this experience but have no desire at this time to criticise or analyze the experiments of others, since experimental work in this line is by no means complete.

In the tests previously reported, half a pound per day was found to be the largest allowance of cotton seed meal that could be safely fed to pigs of less than 100 pounds live weight. In the experiments made since that time this limit has proved to be about right. As age and weight increases the allowance also admits of increase. In the experiments here described we get information as to the dose for pigs of weights varying from 75 to 250 pounds. In some of these experiments, where an excessive allowance has been fed with safety, the animals had become habituated to the food by previous feeding in smaller doses. This evidently increases the resisting power of the animal, but in what degree can not yet be said. In all experiments up to VII the allowance of cotton seed meal was either in excess of or up to the limit of tolerance, and more than could be fed without previous feeding on smaller doses.

From these experiments also we can learn something of the amounts which larger animals, approaching 200 pounds in weight, can tolerate. One pound per day occasioned symptoms of poisoning, though not fatal in experiments I and VI, while in experiment II .7 pounds was found a safe allowance (during a four months' feeding period). In experiment III .8 pounds per day was fed for 156 days, or over three months, to pigs of average weight of 170 pounds (mean weight for the whole period) no harmful effects being noticed. In experiment V the largest allowance was reached—1 pound per day for 70 days to pigs the mean weight of which during this period was about 150 pounds.

Dosage by Weight and Age.—It may seem an incongruity to be dosing out a food to animals as if it were a medicine. Nevertheless, if cotton seed meal is to be fed to hogs to the limit of tolerance, this is how it has to be done. As a matter of fact it would be only under unusual conditions when this excessive feeding should be attempted since, according to our experience, any economic advantages to be derived from feeding this material to hogs will be secured by amounts well under the danger limit, and that independent of its effects on health. The maximum safe allowance, if there is any such, should be determined with certainty by experiments more numerous and extensive than any that have so far been carried out and the figures deduced from our own experiments are given with the knowledge that the next man's work or even our own under different conditions may necessitate their revision.

Some of the data as to the consumption of cotton seed meal in the first seven tests are condensed into the following table the figures referring to each experiment as a whole and disregarding the changes for the minor periods. This table also shows the weights of liver and kidneys per 100 pounds live weight, and the melting point of the lard.

TABLE I. DATA AVERAGED FOR ONE ANIMAL.

EXPERIMENT.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Ch'k a	Ch'k b	Ch'k c
No. Animals	3	3	3	3	2	2	2	3	3	2	4	3	4	1	1	1
Total Cotton Seed Meal Fed (lbs.)	96	93	133	101	144	152	146	92	0	75*	158	52	0*	0	0	0
Days Fed Cotton Seed Meal	123	123	156	173	186	201	185	181	0	94	182	120	0	0	0	0
Cotton Seed Meal Fed Daily (lbs.)	.7	.7	.8	.5	.8	.7	.7	.5	0	.8	.8	.4	0	0	0	0
Days Fed Without Cotton Seed Meal (or Cotton Seed)	44	34	0	0	0	49	0	0	188	0	0	0	....	....	....	....
Final Weight	255	248	262	211	267	250	188	226	189	270	215	117	150	187	136	224
Weight Liver per 100 lbs. Live Wt.	1.3	1	1.1	....	1.1	.9	....	....	....	1.3	1.3	....	1.8	1.5	1.4	1.4
Weight Kidneys (2) per 100 lbs. Live Weight	.24	.22	.2	....	.23	.2	....	....	....	.22	.2	....	.3	.23	.24	.32
Melting Point Leaf Lard (C°)	49	47.1	46.7	....	48.6	49	48.5	47.1	40.7	47	46.7	....	44.3	....	....	....
Melting Point Body Lard	43.2	43.7	44.1	....	46.1	43	43.2	43.1	31.3	45.8	43.8	....	39.1	....	....	....

*Fed Cotton Seed.

Symptoms and Post Mortem Changes.—The present series of experiments afforded little opportunity of advancing our knowledge under this heading. The dissection of one animal, the only one which with certainty appeared to die from cotton seed poisoning, has already been given. The organic changes which ultimately caused death in this case, originated most probably during the preceding heavy cotton seed meal feeding.

As for the *location of the toxin* in the plant, it is obviously present in the kernels or "meat" since these when pressed constitute cotton seed meal. The absence of any toxic properties in the hulls has been conclusively demonstrated by our experiments in feeding large quantities of ground hulls to hogs. Hence the view which attributes the harmful effects occasionally seen in feeding cattle at the oil mills to the action of hulls is probably incorrect.

Active toxic symptoms have not been occasioned by feeding cotton oil but the results of these oil feeding trials are otherwise somewhat indecisive.

Dosage.—For the benefit of those who may wish to "take the chances" on feeding cotton seed meal or cotton seed to hogs some practical suggestions have been put in the summary. It is important that this matter of maximal safe allowance should be determined by many experiments and under varying conditions. The figures given here are based on experiments too limited in number to justify their acceptance as safe guides under all circumstances but they at least furnish a basis for further trials under the best known conditions of safety.

In the first report on "Feeding cotton seed meal to hogs," one-half per cent of the body weight of the animal was given as approximating a proper dose and this is correct for all except the two extremes of growth. Pigs of fifty pounds might get slightly more than one-quarter pound, while for one of two hundred pounds weight an allowance of one pound would be unsafe. The highest allowance recommended is about seven-tenths of a pound per day.

Cotton seed meal has thus been fed at all stages of growth—to pigs just weaned and clear through to the butchering period, also to brood sows, both before and after farrowing. Besides the experiments here reported I have fed it to my own stock mostly in conjunction with bran and corn in the proportion 1, 1, 6 or 1, 2, 6, and although the advantage or profit of this mode of feeding can not be definitely stated no injurious influence at least has been observed.

Effect on Flesh and Fat.—On this point, though no very close observations have been made or could be made without comparative feeding tests, the local butchers to whom the hogs were sold had no fault to find with the carcasses nor comment to make with one exception, where the meat was said to be "gluey." This came from animals in the earlier experiments where the quantity of cotton seed meal fed was excessive.

The melting point of the lard was found to be greatly heightened. These melting points, along with weight of liver and kidneys, are shown in the preceding table.

Financial statements, showing the profit or loss from feeding these cotton food products, would serve no useful purpose since the price of feed will vary in different localities. Here the prevailing prices of both corn and bran have been for several years so high as to make profitable pork raising impossible. Wherever in the South corn can be converted into pork with profit, this profit I believe would be increased by the *careful* feeding of cotton food products as an auxiliary. As for our own experience, where feeding has generally been carried on at a loss, the cost per pound of finished pork has in comparative tests been less when cotton seed meal or cotton seed were added to the ration than where corn and bran were fed alone. The stages of growth at which such feeding might prove most worthy of trial are (1) to the brood sow while suckling young in order to increase the milk flow; (2) to pigs, after weaning, in order to supply sufficient nitrogenous constituents for growth, and (3) during the fattening stage where a small allowance of cotton seed or meal may result in a saving of corn. Of course where hogs find their own existence in the open range, a system of hog raising which still largely prevails in Arkansas, any suggestions as to feeding would be out of place, but there are regions in the state where the open range hog has happily disappeared.

Auxiliaries to Cotton Seed Meal.—To counteract the toxic action of cotton seed meal on hogs it has been suggested that drugs of some kind might be fed with it. A number of the condimental or "stock food" companies taking advantage of the opportunity are endeavoring to push business by recommending the use of their preparations for this purpose. None of these preparations have ever been shown to possess any value under ordinary feeding conditions and only the over-credulous would be likely to experiment with them as adjuncts or correctives to cotton seed meal.

The only suggestions we have to offer in this direction are that animals be supplied constantly with salt and hard wood ashes and especially with an abundance of pure water to further the action of the eliminative organs. If toxic symptoms appear drugs may be called for to produce drastic purgation, but on this point we have no advice to offer here. The aim should be to feed in such a way that no poisoning will occur.

SUMMARY.

1. The toxicity or otherwise of cotton seed meal for hogs, just as for cattle, is a question of dosage. Small amounts may be fed indefinitely, larger quantities for a limited period only, without inducing toxic symptoms.

2. The toxic allowance is determined by the amount per day rather than by the absolute amount fed. Thirty pounds fed in thirty days may cause fatal poisoning while amounts up to 150 pounds in proper daily allowance have been fed without harmful effects.

3. In feeding cotton seed meal to pigs the daily allowance in general should be arrived at from the age and weight of the animals.

4. For continuous feeding the following allowances appear to be well within the danger limit:

Pigs under 50 pounds, one-fourth pound per day.
Pigs from 50 to 75 pounds, one-third pound per day.
Pigs from 75 to 100 pounds, .4 pounds per day.
Pigs from 100 to 150 pounds, one-half pound per day.

5. If fed a full grain allowance, the dosage may be obtained by properly proportioning the cotton seed meal to the other components of the ration, namely, 1 to 5, 6, 7 or 8 according to the stage of growth.

6. When pigs obtain part of their feed by grazing a proportion of 1 to 4 or 1 to 5 can be fed by diminishing the grain allowance.

7. A meal ration containing cotton seed meal should also contain at least an equal amount of wheat bran to supply bulk. For the remainder corn appears to be the only choice.

8. In a ration for hogs cotton seed meal can only be used as an adjunct and corrector for a basal corn ration, and this is obtained by the proportions mentioned. At the price prevailing and likely to prevail for cotton seed meal it is doubtful if larger amounts could be economically fed even independent of the toxic effect of the food.

9. In the amount prescribed above cotton seed meal can be fed indefinitely as to time just as any other feed.

10. With the same breed of pigs a ration of cotton seed meal, bran and corn, in various proportions has made quicker and more profitable gains than bran and corn alone, and this at all stages of growth.

11. Cotton seed meal has not been found to exert any specially harmful influences on breeding stock independent of its general toxic effects.

12. Cotton seed (chopped), although eaten at first reluctantly and always with some waste seemed so to supplement or economize the corn ration, with which it was fed that a relatively cheap production of pork was produced by its use. (Based on one test only.) It would seem that on account of its cheapness to the southern farmer it might, if fed carefully, be utilized in pork growing. The daily allowance should be about the same as for cotton seed meal and the feeding done in such a way that this allowance could not be exceeded.

13. Cotton seed and corn make probably the best combination, about 1 to 6 or more, if on full feed, or 1 to 3, 4 or 5 if on short allowance of grain.

14. Where hogs are allowed free access to cotton seed they will likely poison themselves unless freely supplied with other food in which case the amount eaten may not be sufficient to cause poisoning.

15. We have had no experience with cotton seed rotted, roasted, steamed or otherwise treated, but believe the harmful influence to be about the same in character and degree as in cotton seed meal, being located in the kernel or "meat."

16. Cotton seed hulls are not toxic for hogs and hence probably not for cattle either. They are only available for hog feed when ground into a "bran" and at the price charged this "cotton hull bran" is unprofitable.

17. "Cotton seed feed" should also be avoided as a hog feed.

18. Crude cotton oil when fed apart from the kernels has not occasioned symptoms such as we found in cotton seed meal poisoning, although in the quantities fed it seemed to act harmfully, giving rise to unthriftness and possibly even death. These conditions may be the effect of an over-oleaginous ration or of a special toxin. Our trials have not yet decided this matter.

19. The economy or profit to the southern planter of feeding cotton seed, or cotton seed meal to hogs is a subject worthy of more extensive investigation than it has yet received, such investigations being made along the lines suggested in this report. Guided by these suggestions as to rations, the prospect is favorable, but feeding in ignorance or indifference of these will only result in loss.

20. The idea that cotton food products can ever take the place of corn in pork production in the south may well be abandoned. They can not replace but may prove valuable adjuncts to corn or any other starchy or carbohydrate food which may be found available in the south for hog feeding. The conditions here are not the same as in cattle feeding where the hulls are available for roughage.

THE NATURE OF COTTON SEED POISONING.—The present series of experiments did not afford much opportunity for further studying this problem. The following based upon such opportunities for observation as we have had may be provisionally set down as the course or sequel of events in cases of over feeding with cotton seed or cotton seed meal. Congestion of the eliminative organs—liver and kidneys—followed by one of three conditions according to the degree of over feeding:

(a) Progressive engorgement with impairment of function leading to acute dropsical effusion into the various serous cavities and death within two months or less. This is the most acute form.

(b) Primary engorgement as above followed by degenerative changes, fatty and atrophic in the liver, sclerotic and atrophic in the kidneys, with progressive loss of function.

(c) Congestion of less degree which the organs become more or less habituated to and in which only slight and temporary symptoms develop and no marked organic changes are found.

(d) Long continued feeding on cotton seed meal in the safe doses prescribed above has given rise to no gross organic changes in liver, kidneys or other organs discoverable on slaughter. No fault has been found by the butcher purchasing our animals as to the quality of the flesh or fat. Prolonged feeding on cotton food products has been found to greatly heighten the melting point of the lard.

INOCULATION AGAINST TEXAS FEVER.

(Vet. Circular No. 3.)

Object.—The ultimate purpose of this inoculation is to aid in improving the quality of the native cattle of the South by grading up with imported bulls of the improved beef stock—Shorthorns or Herefords chiefly. This it does by immunizing or protecting these against Texas or Tick Fever. Native cattle of this State and other States south of the quarantine line, whether blooded stock or scrubs, are already immune and need no inoculation; but the number of animals of the improved breeds in the South, and especially in Arkansas, is so small that importations are usually made from northern States. These northern bred cattle when brought south invariably sicken of Texas fever, and two-thirds of them, on an average, will die of the disease.

Nature of the Disease.—It is a germ disease in which the infection is conveyed into the blood by the "bites" of ticks just as malaria of man is transmitted by the mosquito. A "ticky" region, that is, one where the large cattle ticks are common, is to be regarded as a Texas Fever region and unsafe for northern stock.

Mode of Inoculation.—As now practiced this consists in injecting under the skin a small quantity of fresh, warm, defibrinated (or whipped) blood from a native steer, which has lately carried ticks, or from an animal which has lately recovered from Texas fever. Both of these sources are used and it can not be said as yet which is the best.

Season, Age and Other Conditions.—The proper season to inoculate is during winter or late fall, in Arkansas from Nov. 1 to Feb. 1. When done at other times there is more risk both from the inoculation itself and from co-incident infection by ticks.

The best *age* is from five to fifteen months. Older than this increases the risk.

Inoculation may be done in the North before shipment or immediately after arrival in the South. In the latter case there are some precautions to be taken, if ticks are still on hand, in order to prevent infection before the inoculation takes effect.

Results.—Statistics coming from eight of the southern States where inoculations have been carried on, and embracing some five thousand animals, give a loss of from 7 to 8 per cent after inoculation, this including those that die from the inoculation and those that failed to receive protection and died from later tick infestation. (Bul. 90, S. Carolina.) Since the deaths of unprotected susceptible cattle exceed 60 per cent inoculation must be considered a practical success even if the results above given should prove too optimistic.

Inoculation by the Experiment Station.—The first requirement in increasing the profit of cattle raising in Arkansas is the replacement of the unprofitable and almost unmarketable native scrub by grades of the improved beef stock and the Experiment Station offers its aid in this direction by free inoculation of imported registered stock to any one making application and complying with certain conditions, the chief of which are that the stock must be destined for distribution in this State alone, and the number must be sufficient to justify the expense of travel, etc.

(The northern tier of counties in Arkansas are not Texas Fever regions, and northern cattle require no protection there.)

Parties contemplating the importation of cattle stock from anywhere north of this State should import, during the winter months, and if they wish to have their stock protected by inoculation should write the undersigned for advice before making shipment.

R. R. DINWIDDIE,

Agricultural Experiment Station, Fayetteville, Ark.

Part I. Asparagus and Salt.
Part II. Asparagus-Growing in Arkansas.
Part III. Rhubarb in Arkansas.

BY ERNEST WALKER, *Horticulturist.*

Fertilizers Registered for Sale in Arkansas During 1905.

BY A. M. MUCKENFUSS, *State Fertilizer Chemist.*

PART I.

Asparagus and Salt.

BY ERNEST WALKER, *Horticulturist.*

BRIEF REVIEW.

The application of common salt as a manure was long considered one of the essentials in asparagus growing. With few exceptions the books on gardening written by practical men some years ago recommended the liberal use of salt.* The greatest benefit was claimed to be on old plantings.

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* The following notes show the views of some of these writers, as well as those of a few more recent, regarding the value of salt in asparagus culture.

White recommended a top dressing of salt, two pounds to the square yard before growth commenced. Again a liquid manure for beds, composed of one ounce of guano and four ounces of salt to two gallons of water.—Wm. N. White, Gard, for South, 1858, p. 170.

Burr recommended autumn working and salt at the rate of two quarts to the square yard.—Garden Vegetables, 1866, p. 78.

Brill says, "coarse salt may be used after the third year at the rate of five bushels to the acre, along the rows, or three times this rate if sown broadcast. Some argue a heavier dressing will be beneficial, and even assert that salt may be applied to the crop broadcast one-half inch thick over the entire surface. I would not recommend using more than the quantity first named, and it is doubtful whether this would be beneficial near the sea-coast, * * * * * except sa far as it may have a tendency to destroy weeds."

Farm Gardening and Seed Growing, 1872, p. 43.

The Farmer's and Gardener's Encyclopaedia of 1867, does not mention salt for asparagus, except in one instance when in describing the French method of dressing beds then in use, it mentions the application of "six inches of manure and four of sea sand if procurable, otherwise river sand or fine earth."

Henderson says in one of his works, salt is claimed to be of benefit in inland districts, but is of little or no benefit in the vicinity of salt water,—apply in early spring one-half pound per square yard, on surface. Besides beneficial effects upon the plant, it is to some extent destructive to the wire worm and other insects troublesome to asparagus. Later he does not recognize the old practice as of any practical value.

As to the value of salt for asparagus, opinions differ, not so much in the matter of its value as a direct fertilizer, but in regard to its indirect value. The present trend of opinion seems to be that it is of little if any value even indirectly, and by no means necessary.

It is well to observe that with this change of view the methods of growing asparagus have undergone a radical change. At present the crop is grown commercially in fields, in a much less expensive and far less laborious way than of old, and happily far more extensively. The old method of growing asparagus in use when salt was considered so essential, was in closely planted beds, usually prepared by "trenching" to a depth of from two to five feet, heavily manured, and enriched annually by applications of enormous amounts of stable manure. Probably no other garden plant was ever given such deeply and thoroughly prepared soils as asparagus. When once made a bed was expected to last some twenty years or more, but not with-

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Gard. for Profit, 1886, p. 125.
Hand Book of Plants, 1890.

Ohmler remarks that the natural habitat of asparagus being the seacoast, it is benefitted by applications of common salt, which may be used in sufficient quantities to destroy weeds—say 600 to 800 pounds to the acre, particularly if the crop is at a distance from the sea shore."

Truck Farming, 1894, p. 126.

Rawson recommends salt in the following words, "Salt is an excellent thing to apply for a dressing, for, although it does not act as a manure, as some people think, it is a great help in keeping down weeds.—Rawson W. W.—Success in Market Gardening, 1892, p. 82.

A work on English and French methods recommends salt as of great benefit in inland districts, and considers it of little or no value near salt water; of especial value on old plantings. Injurious to newly set plants. Besides its beneficial effects as a manure it is destructive to wire worms. Apply in moist or rainy weather at the rate of two pounds to the square yard. Two applications.

Asparagus Culture, Barnes and Robinson (no date).

Landreth states that twenty bushels of salt to the acre may be used to advantage annually. Again, that five bushels to the acre stimulates the asparagus which is a salt plant, and retards weeds. Mentioning it again he says, by its affinity for water keeps land moist. Though "not primarily a manure it may on some soils have a good effect in helping to set free more important constituents, and in driving away insects and grubs."

Burnett Landreth, 999 Queries and Answers, 1895, pp. 42-46, 86, 171.

A recent work—"The practice of sowing salt on asparagus is almost universal. Still beds which have never received a pound of salt are found to be as productive as those having received an annual dressing, nevertheless, a salt dressing is recommended."—Hunn and Bailey, Amateurs, Pract. Gard. Book, 1900, p. 23.

Waugh, in speaking of the practice says, "dressings with salt are often advised, but their value has not been fully ascertained."

Garden Making, 1898.

Other important recent works omit mention of salt in connection with asparagus growing.

Ency. of Am. Horticulture, 1900.
Principles of Vegetable Gardening, Bailey, 1901.

"When potash salts (kainit and muriate) are used, the application of salt will be superfluous, even if it is ever necessary. On clayey soils salt is always dangerous, causing the soils to run badly, and become pasty, while its benefits, except as a weed destroyer, are of a doubtful character," says Handy (1).

(I) Handy, D. R.—Asparagus Culture, Farm Bull. No. 61, U. S. Dept. Agric. 1897, p. 21.

Voorhees.—"There is no real fertility in it, * * * * * and its indirect benefit may be obtained more cheaply by the use of other materials which contain salt as a normal ingredient." (Kainit.)

Voorhees Fertilizers, 1898, p. 266.

A successful practical grower in Virginia, noticed in Handy's work, recommends 500 pounds of kainit (which contains about 33 per cent of salt) per acre sown broadcast every third year—similar amounts of raw bone being given each year in the intervals.

out annual working and heavy dressings of manure and salt each year. (The latter in lieu of hand weeding.)

The wild asparagus plant, a native chiefly of southern Europe, along streams and seashores, seldom grows over a foot or eighteen inches high, with stems the thickness of straws. Under the system of cultivation just outlined the spears frequently weighed from three to five ounces each, indeed there are records of some weighing half a pound. The process was analagous to the "stuffing of a goose."

As to the salt, the plant being a maritime species, quite naturally, at that date, led to the supposition that this substance was necessary. Indeed chemical analysis revealed the fact that the herbage contained considerable quantities of sodium. Hence the inference that the plant required salt. It was therefore used as a direct fertilizer; later, for its indirect value.

The fact that a plant may naturally take up relatively large quantities of a chemical substance from the soil is not at the present time taken as evidence that such substance is of value, or necessary to the plant. Plants under some circumstances may take up substances from the soil which are of no obvious benefit to them because favorably situated for doing so, and because they tolerate them. Such is the present view regarding plants such as asparagus, which, under suitable conditions, absorbs comparatively large quantities of sodium. Sodium and potassium being similar chemically it was formerly thought by many that the sodium could replace potassium functionally in the plant, and this has been maintained in recent years by some agricultural writers. Recent experimental results in this country wholly disprove this view.* On the other hand, in recent years some European investigators† have recorded results which seem to indicate a value in sodium (sodium chloride), and quite recently the Rhode Island Experiment Station,‡ in the published results of a study of the question, states that "Sodium has little or no direct manurial action, but may influence the growth of certain plants through its effects upon the chemical reaction of the soil."

EXPERIMENT WITH SALT AS A FERTILIZER FOR ASPARAGUS.

A single season's results at this station in the use of salt on asparagus in large quantities indicated a beneficial action, mainly attributable to the effect of the substance in preventing the growth of weeds, but not wholly so it would seem.

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* Jordan and Jenter, Bull. 192 N. Y. (Geneva) Agr. Ex. Sta., Dec., 1900.

† Alterburg, Deut. Landw. Presse, 1891, p. 1035. Abs. E. S. R., 3, p. 554, and Wagner & Dorsch, Die Stickstoff d. Landw. Kulturpflauzen, Berlin, 1892, pp. 227-242.

‡ Wheeler, Hartwell & Adams, concerning the function of sodium when used in Nitrate of Soda. (Rep. R. I.) Agr. Exp. Stat., 1903.

The work was entered upon in the beginning of my connection with this station in 1900. Although now in progress the work has been interrupted for three years by the destruction of the plot of asparagus then being used for the experiments, which came about through changes in the grounds due to the erection of a new dormitory on the campus. The results obtained were much more pronounced than I would have expected. They were a surprise. They are given here, however, with emphasis on the fact that they represent only a single seasons test.

The planting, which was in its second year at the time the experiment was started, embraced one-seventh of an acre, and consisted of twelve equal rows running north and south, including four varieties, three rows of each, viz: Columbian Mammoth, Conover's Colossal, Barr's Mammoth and Donald's Elmira. The plants stood two feet in the rows, (three to four feet would be better), and the rows were four feet apart. The area was level. The soil consisted of a poor sandy loam with good natural drainage, and was quite uniform, as was shown by the previous growth of the plants on it. It had not been manured, but was given a uniform coat of well-mixed stable manure in the spring of 1901. The south end (one-fourteenth acre) embracing half the patch, was selected to receive the salt. In the summer of 1900 an application of salt, broadcasted at the rate of 1000 pounds per acre, was given. No cutting was done that season, but as far as could be seen there was no appreciable effect upon the growth of the plants, nor in preventing the growth of the weeds.

The following spring a much heavier application was given the same part which had received salt the preceding season. Two pounds per square yard were applied in two equal applications at intervals of twenty days.

The total yield of each variety and for all varieties under each treatment, and the average per plant, are given in the following table:

TABLE I.

SALT AS A FERTILIZER. NINETY-SIX PLANTS OF EACH VARIETY.

YIELDS FOR THE DIFFERENT VARIETIES WITH SALT AND WITHOUT SALT

	Without salt. ($^{1}/_{14}$ acre)		With salt. ($^{1}/_{14}$ acre)	
Name of variety.	Total yield in ounces.	Average per plant in ozs.	Total yield in ounces.	Average per plant in ozs.
Columbian Mammoth....	195.84	2.04	207.36	2.16
Conover's Colossal......	187.20	1.95	230.40	2.40
Barr's Mammoth.......	249.60	2.60	271.68	2.83
Donald's Elmira........	249.60	2.60	290.88	3.03
Total yield, 384 plants.	882.24		1000.32	
General average per plant		2.29		2.60

These results show a decided difference in favor of the salted area amounting to 13.5 per cent, or a difference of 103.32 pounds per acre for the planting in its third year.*

The difference was not confined to the spring growth. There was an increased vigor manifest throughout the summer, and furthermore a noticeably *increased glaucous* appearance in the salted plants.

In the quantity used; salt proved indeed efficient in preventing the growth of weeds. Without any hoeing whatever but very few weeds appeared, and those late in the season. While in the unsalted part they appeared abundantly as the season advanced until the end of cutting when the entire planting was "worked over."

While the beneficial action of the salt was attributed in part to its effects in preventing weeds, in this sandy soil there appeared to be an effect and beneficial action beyond what weeds appearing during the brief cutting period would wholly account for.

THE VALUE OF SALT UNDER THE OLD METHOD.

While good asparagus, as is well known, may be grown without applications of salt, it is possible that on asparagus soils, soils of the sandy type, still better asparagus might be grown with it. It is certain that in the usual quantities it does no harm to the asparagus on such soils. It is known to have a binding or compacting effect on lighter soils, and tends to improve capillarity, while, owing to its hygroscopic character it tends directly to increase the moisture in the soil. Even if impracticable under present methods to use salt in the large quantities needed to secure its effect, it is certain that under the old time method of growing asparagus it was well nigh a necessity and answers a good purpose still where asparagus is planted closely in beds. Planted thickly, as was the custom, it was almost impossible to keep the bed clear of weeds by any other method. The large quantities of stable manure used annually brought a fresh supply of weed seeds, especially grasses, rendering hand work tedious and expensive. Salting proved an efficient, cheap and harmless substitute.

A MODERN VARIATION IN ASPARAGUS GROWING IN WHICH SALT ASSISTS.

The writer has used asparagus along division and back fences where it serves the double purpose of ornament and use. It softens and hides the obtrusive division fence, with its airy growth proving indeed ornamental. It occupies ground that is often not otherwise occupied and at the same time such plantings can be made to furnish a family supply of a delicious vegetable. It is true that with the attention usually given the product is not comparable to the truckers' product, but a very fair article may be so grown and as it is for home consumption its smaller size is not seriously in the way. Here salting again answers a good purpose; waste brines may be put to use. This combination of utility and ornament in many instances is not desirable, but here we have one in which ordinary objections hardly apply.

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* Cutting began April 12th and continued till May 11th. All the varieties reached their maximum yields May 3rd. Donald's Elmira gave the best all around total yield for the season under the conditions of the test. In the table the varieties follow in the order of yield.

PART II.

Asparagus-Growing in Arkansas.

BY ERNEST WALKER, *Horticulturist.*

Asparagus, one of the earliest and most wholesome garden vegetables, at present receives almost no attention in Arkansas, either commercially or in home gardens.* It may be grown by simple and inexpensive methods, but ideas based on the old method of constructing asparagus beds are still common, and no doubt often tend to discourage the cultivation of this vegetable. It should receive more attention.

Its season here begins about April 12th. Appearing thus early, before other garden vegetables and when the appetite craves something of this character, its extreme delicacy, suiting it even to the palate of invalids, render it one of the most desirable in the list of garden productions.

Not only should it be commonly found in the home garden, but it is worthy of increased attention as a commercial crop. Its "grass" is easily packed and well suited for shipment long distances.

It is now grown commercially in several states†, California, with 2,368 acres being in the lead in extent of area devoted to the crop. Then in order follow New Jersey, 2,089 acres; Massachusetts, 995 acres; New York, 811 acres; Illinois, 767 acres; Pennsylvania, 596 acres; South Carolina, 403 acres.

The total area devoted to the crop in these several states is 8,029 acres, which is 78.8 per cent of the entire acreage devoted to asparagus in the United States.

The average production per acre in bunches for several states, as given in the census, varies considerably, ranging from 882 bunches in South Carolina to 1,980 in Minnesota. New York produces 1,317, which is about the yield reported for Arkansas—1,320.

With well fertilized soils and good cultivation the yield is from 1,800 to 2,000 bunches per acre, worth about $180 to $200 per acre. In some cases larger yields may be had, $300 per acre being possible.

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* In 1899 there was one acre credited to the State in the U. S. Census.

† Twelfth U. S. Census.

An average price is perhaps 10 cents per bunch, that is at the canning factories or at wholesale. In the smaller towns the price often runs from 15 to 30 cents a bunch. Poor asparagus is apt to be tough and unsalable.

The vegetable is disposed of in three ways: to the dealer or immediate consumer; to canning factories, and for home use fresh, or it is dried.

ASPARAGUS FOR THE HOME GARDEN.

A few dozen plants, with some care, will supply the needs of an ordinary family. The plant may be used in some instances along division fences, as previously suggested, for the combined purpose of ornament and utility. In this case salt will be found helpful for keeping down grass and weeds. With manuring and salting the writer has grown a fair article in this way for home use, and has been more than pleased with the results.

Salt will be found useful for asparagus when the smallness of the area available necessitates close planting and high manuring, or an approach to the old-time method. It is better to give the plants more room however if the space at command will permit. Planting in one or two long rows is better than the close set asparagus bed.

As a rule it will be more satisfactory to buy the few plants needed for the home garden than to grow them from seed. Strong selected one-year plants are the best. Two-year plants are much less desirable, while divided old crowns, which are more or less exhausted, should be rejected at any price. However, young well-grown crowns, two or three years old, which have not been weakened by bearing, may be used.

Have the ground deeply plowed and liberally manured with rotted manure. Set the plants in the spring in wide-open furrows with the crowns six inches below the surface. Let rows be four or five feet apart, and the plants three to four feet apart in the rows. They are frequently given only one or two feet, which, of course, necessitates increased attention to fertilization. At first the crowns are covered only about two inches deep. Further covering is given from time to time during the subsequent cultivation until finally the furrow is filled.

Clean level cultivation should be given throughout the summer, especially after rains, to avoid the formation of a crust on the soil, and to conserve moisture.

Each spring work in the surface a dressing of rotted stable manure. In bearing beds a supplementary dressing at the close of the cutting season will prove highly advantageous, supplying, as it deos, plant food at a time when the crowns are in a somewhat exhausted condition and in need of stimulation. A vigorous summer growth increases the yield the following year.

In bearing beds let cultivation begin early in the spring. Work up the surface along the rows and then turn the mellow soil onto the row with a turning plow, leaving a dead furrow between the rows. This ridges the land and by its warming effect stimulates growth and earliness. White asparagus results from cutting the spears before they have appeared above ground. If green asparagus, which is more highly flavored, is preferred, the ridges need not be so high and the speers are allowed to shoot up some inches above the soil.

No cutting should be done till the third year, when half a crop may be gathered. In well established beds the full cutting season lasts from six to eight weeks. The gathering during this period should be daily and clean. Care must be used to avoid injuring the crowns by the knife. Irreparable damage may be done by carelessness in this matter. Injury to the crown tends to multiply shoots at the expense of size. The knife should be inserted vertically beside the spears. Some growers use the finger, breaking off the spear clean at the crown.

Later on the shoots are allowed to grow, and good cultivation should be given at frequent intervals to secure a vigorous summer growth. When the tops have been killed by the fall frosts they should be cut off close to the ground and burned.

The varieties mentioned in Table I are all common in cultivation and among the best varieties. Donald's Elmira gave the best yield in the test reported. It is becoming increasingly popular. Conover's Colossal and Palmetto have been perhaps the most widely grown. As a rule, however, the quality of asparagus is more a matter of cultivation and fertilization than of varieties.

ASPARAGUS FOR MARKET.

Asparagus may be grown in all parts of Arkansas where the soil is not too wet, and it is worthy the attention of growers who are favorably located for meeting the needs of the crop and marketing it.

The method of field culture is much simpler, and relatively far less espensive than that formerly considered necessary. Instead of the compact bed and laborious hand work formerly required, the plants are set out in a well-prepared and manured field where all the cultivation may be done by horse power.

The plant is a rich feeder. The space allowed the crowns in the method of field culture and good preparation of land, in part meets the requirements, although liberal fertilization is required aside from these to produce satisfactory annual yields of good marketable asparagus. Hence a location within reach of a good sized town where manure may be had in quantities offers the greatest advantages.

The crop is well suited to shipping long distances, and when packed is less bulky than many other garden crops.

Compared with other ordinary crops the first cost of planting is rather expensive, three years being required to bring a planting to bearing age. When once established, however, the field may be made to yield profitably for years, so that the cost of planting is borne but once in a number of years. Moreover the distances between the rows admit of the cultivation of early garden crops, such as strawberries, pease, onions, potatoes and spinach between the rows the first two years, which may be made to assist materially in reducing the first cost.

SOIL.

As far as mere yield is concerned, asparagus will accommodate itself to a wide variety of soils. For the purpose of the grower for market, however, the soil should be a warm, fairly porous sandy soil, free from stones, roots, etc., and any inclination to be wet. The subsoil should be open clay. Such a soil is "earlier" and its friability reduces the cost of cultivation.

The area should be free and open, fully exposed to the sun the entire day. A grove or windbreak to the southwest, north or east, according to the direction of the strong winds, will be advantageous. The best exposure is towards the southeast or southwest, with rows running north and south, or as nearly that direction as the lay of the land will allow.

PREPARATION OF THE LAND.

The land should be deeply plowed in the fall, subsoiling will be necessary unless the subsoil is already sufficiently porous. After harrowing the land should receive a good dressing of manure, which should be turned under the following spring. Asparagus loves liberal manuring, but the enormous amounts once recommended are not indispensable. It is not possible only in rare instances to get such large amounts except for very small areas. Moderate amounts, say twenty loads per acre, to be supplemented by the cheaper concentrated commercial fertilizers, is necessary in plantings of considerable size. Indeed smaller amounts, where supplemented in this way, have given the best results, and a more tender product than where stable manure alone was used.*

THE PLANTS FOR SETTING.

Where the crop is for market purposes it is much better usually to grow the plants than to buy them. Nurserymen and others offer the roots for sale at from $2.50 to $8.00 per thousand, but the buyer usually can know nothing of the previous history of these plants. Commonly they represent an indiscriminate lot of seedlings, and sometimes divided old roots. By growing ones own plants there is opportunity for selecting for planting only the best, besides it is cheaper to grow the plants when many are to be used. Asparagus is pre-eminently a crop in which the principle of selection should be applied. Selection of good seed plants, selection of the best seeds, and finally the selection of the best plants. The only way of getting such is commonly for the planter to grow them himself. The species is dioecious, that is, bears male and female flowers on separate plants. Experimental results* obtained indicate that the best yields are produced by the male plants. They are somewhat earlier also and produce larger shoots. In two-year-old seedlings the sex of the plants may be known—sometimes, in strong yearling plants, grown under favorable conditions of soil and cultivation. It may therefore be worth while to carry the principle of selection to the point of planting only male plants.

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* Field Experiments on Manuring of Vegetables and Fruit Crops, F. W. E. Shrivell and B. Dyer, Vinton & Co., London, 1902.

When to be grown in the open ground, as is the common practice, the seeds should be planted in early spring or as early as the ground can be worked during the winter. Drill them in furrows an inch deep, and from one to three feet apart, according to convenience in cultivation, placing the seeds three inches apart in the row. It pays to select a good piece of soil for them and give them good cultivation, as by so doing as large plants may be grown in one year as otherwise would be possible in two.

Frequently the seeds are started in February or March in hot beds, or the green house, in rich soil. When three or four inches high the best plants are selected and placed in two-inch flower pots. These are repotted one or more times until the season for planting out doors arrives, when they are planted out in the ground. It is possible by this method to grow very strong plants in a single season, while it makes easy the selection of the best plants. Many of these seedlings will be rejected, for which reason it will be well to sow several times as thickly as would ordinarily be done.

Asparagus is sometimes propagated by division. In this way the characteristics of good varieties or individual plants, can better be retained, and thus the entire planting formed of male plants. This has never been as satisfactory as the method of growing plants from seeds. The chief objection to it is the divided plants have been old plants which have been exhausted or weakened by previous yields and treatment. If strong young plants are grown for the purpose of division and not previously weakened by cutting, the common objections to this method of propagation would not hold. Indeed, it would present great advantages, enabling the operator to better maintain varietal or individual characteristics, and have whole plantings of male plants. The time required, however, renders this more expensive than seed propagation and is a serious drawback.

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* Bull. Ohio Agric. Expt. Station, Vol. 3, No. 9, 2nd Series, 1890.

SETTING THE PLANTS.

Asparagus plants are preferably set out in the early spring. For the purpose, lay off the previously prepared land in furrows five feet apart, using a large plow, running in the same furrow several times. This deep furrow allows of readily placing the crowns from four to six inches below the surface, the lighter soils admitting of a greater depth. In the row the plants are given from one to five feet according to the preference of different growers—four to five feet is desirable. The plants all having been placed are covered only two or three inches deep at first. Later the furrows are filled during cultivation when the plants have shot up. Cultivation should be clean, frequent and thorough throughout the summer.

At the end of the summer, when the stalks begin to die, they should be cut off at the surface of the ground and burned. If full of seeds the old stalks should be carried out of the patch for burning.

Asparagus rust is especially liable to appear and do damage in the warm soils of this region. By following up carefully the fall treatment just mentioned, we have kept it under control at the station and have reduced injury in a badly infested patch to almost nothing.

Asparagus commences to bear seed the second year. The practice just recommended is partly to prevent, as far as possible, the growth of asparagus seedlings in the rows, where they are as objectionable as weeds and harder to eradicate.

CULTIVATION,

Cultivation should receive especial care from the start that weeds may not overtop the planting. By the third year, if the planting has received the generous treatment it should have, the summer growth should be so luxuriant as to well-nigh completely shade the ground and crowd out grass and weeds. It is well to remember that this growth of tops, meeting across the five-foot rows, represents a correspondingly larger root system, and the roots at this time interlacing completely occupy the soil. There is a corresponding need of large amounts of moisture. This summer growth is storing up strength for the next years crop. The plants may endure neglect, but the owner cannot well afford it. Aside from the question of grass and weeds surface tillage is needed throughout the summer to conserve the moisture. Conserving moisture is, in a sense, indirect irrigation.

Each fall, after the summer growth has been removed, a turning plow should be run along either side of the rows throwing the soil away from the row. This removing part of the soil over the crowns benefits by giving air, rain and frosts a better opportunity to exert their mellowing effects on the more or less compact soil above the crowns. No danger of injury to the crowns may be apprehended as long as they are covered with two or more inches of soil.

In the early spring as soon as the ground is dry enough to work, by means of a turning plow, throw the soil back on the row. Cultivate thoroughly and work the mellow soil toward the rows. This results in the formation of low ridges of mellow soil above the rows with dead furrows between. This tends to stimulate growth and earliness.

For bleached asparagus these ridges should be made higher than for "green." Some markets prefer the green, which is indeed preferable. As a rule, however, the bleached appears more attractive to the buyer and sells somewhat the best. The difference is in the cutting. For green asparagus the spears are allowed to grow five or six inches above the soil. The bleached is cut before it reaches the surface. Hence the need of somewhat higher ridges when this form is desired.

The low broad ridges should be cultivated from time to time, and renewed, as they tend to settle and rains beat them down. They should be kept smooth and mellow and free from weeds.

For cultivation use a small-toothed cultivator or light harrow immediately after the cutting. A harrow, composed of two sections hinged in the middle, and of sufficient width, may be made in two-horse form to work astride the ridges. After the cutting season the ridges should be plowed down and level cultivation given throughout the summer.

FERTILIZERS.

Practical growers, as a rule, prefer barn yard manure, and no doubt it is commonly the best. For while supplying the three important kinds of plant food it supplies humus and improves rapidly the physical condition of the soil, which is, in many ways, even more important than the addition of the elements of plant food. It should be used as freely as the supply available will allow, as asparagus is a rank feeder. As manure contains a larger proportion of nitrogen than of the other two important elements, its quality may be improved and the supply made to go farther by the addition of fifty pounds of muriate of potash and 100 pounds of finely ground rock phosphate per ton. Manure should moreover be under shelter and protected from the rains. It is well commonly to get it on to the land where needed as soon as possible.

Aside from its mechanical effects, about twelve tons at least of horse manure per acre are required for asparagus to supply the needs of the crop for the elements, potassium and phosphorus. Yet this supplies about eighty-two pounds of the expensive and leachy nitrogen in excess of the needs of the crop. Manure is often applied in the fall and a large part of this nitrogen may not only be wasted on the crop but permanently lost applied thus, and in this quantity. By the addition of the substances above mentioned to the manure, from one-half to one-third the amount of manure mentioned may supply the food needed by the crop.

These materials may also be added to the land separately in the same ratio, with a corresponding reduction in the amount of stable manure needed. Other substances, such as kainit, may take the place of muriate of potash, but containing only about one-fourth as much potash, about four times as much will be required as of the muriate. It contains besides the lower per cent of potash 35 per cent of salt, which however in the above amounts would be of little or no consequence.

Potash may be supplied in the form of unleached hardwood ashes, which contain 6 to 10 per cent of potash, besides 30 to 40 per cent of lime, and larger amounts of lime when they come from lime kilns. They should never, of course, be mixed with organic manures, but applied to the land directly, from ten to fifteen tons per acre being required.

Raw bone meal is much used by growers at the rate of 500 pounds per acre. This supplies the need of the crop for phosphoric acid, and some nitrogen as well, but less than half of the latter needed.

One thousand pounds of a fertilizer consisting of the following would be better than the bone alone, supplying all the essential fertilizer elements:

Raw bone, ...	500	pounds.
Muriate of potash, ...	200	"
Cotton seed meal, ...	200	"
Nitrate of soda, ...	50	"

These ingredients may be varied by supplying their equivalent in other forms. Indeed, it is desirable to do so from year to year.

If stable manure is freely used the first few years it may be used in lesser quantities subsequently. It might then be applied every third year, using the commercial fertilizers in the interval. As for salt, it is unnecessary and impracticable to apply this substance broadcast in the quantity needed for killing weeds when asparagus is grown according to the field method.

The usual practice is to apply fertilizers to asparagus in the fall. The spring, however, is a better time. Some of the fertilizer, especially the more insoluble plant foods, might then be applied in March, or earlier, the soluble and more quickly available, later in one or two applications, say, in April and June, just prior to time when the plants make their summer growth. This method aims at supplying the plant food when the plants are active and prepared to make the most of it.

MARKETING.

In well-grown plantings a light crop may be cut the second and third season, but it is better to wait till the third at least before beginning cutting. When cutting begins the stalks should be taken clean every day. The period of cutting lasts from six to eight weeks, according to the vigor of the plants. An asparagus knife is desirable for the work. Such are to be had of dealers.

Stalks are sorted according to size into grades, and are then bunched. The grades are designated as extras, primes and seconds. Asparagus bunching devices are readily procurable from dealers in garden appliances. Home-made devices are frequently used, the idea is to have the tops equal and uniformity in the size of the bunches. Regularity in length of spears is secured by cutting off the *base* of the bundle. Neatness of appearance is given by using stalks of uniform size for the outside of the bundles. From ten to forty or fifty spears make a bunch, according to the quality of the "grass." Bunches are eight to ten inches long and about four and a half inches in diameter, weighing two and a half to three pounds. The ordinary bunches seen for retailing in western markets weigh about one-half pound.

For shipment these are packed in neat crates holding from two to three dozen of the large bunches. The bunches are closely placed standing with their bases on moist moss to prevent drying. A crate, twenty-four inches long, seventeen inches wide and twelve inches deep, holds two dozen bunches of the large size. To conform to the shape of the bunches and secure better packing, it is made three inches narrower at the top than at the bottom. It may be somewhat shallower for shorter bunches. Another size crate is twenty-eight inches by twenty-two inches by nine inches deep. This holds thirty bunches.

FORCING.

Asparagus may be easily forced, but being grown in warmer places for shipment, it is doubtful about its paying as a commercial proposition here. So I have omitted a description of the methods used.

INSECTS AND DISEASES.

The asparagus beetle (*Crioceris asparagi*), and a related species, are common pests in some parts of the country, doing (especiallly the former) considerable damage. Neither of the species have appeared here however.

The well known asparagus rust (*Puccinia asparagi*), which is a minute parasitic plant living in the tissues of the asparagus plant and sapping its life, is almost everywhere present here. There is scarcely a tuft in any private garden but annually suffers seriously from the presence of this disease. Affected plants have a dull yellowish—later in the season a blackish—appearance. The leaves are caused to fall and the tops to die permaturely. On close inspection the stems are seen to be thickly marked by small ruptured blisters from which issue yellowish or brownish dust—the reproductive bodies, the late crop of which (*teleuto-spores*) carry the fungus over the winter. They develop the following season and then affect the new growth and new plants. Old and young plants are affected alike. Seedlings only a few weeks old are often seen showing the characteristic yellowish fruiting dots (*uredo-spores*). The disease is more serious during drouth and in dry situations, and is influenced to some extent as to the time of its appearance by weather conditions. The earlier in the season it appears the more injurious the disease is likely to be that year.

The pustules seem not to extend down the stems to the ground or beneath it. My observation here has been that the lower two or three inches of the stem are free from the rust spots, as well as the portion below the ground. Cutting off the stems with a hoe *at the surface of the ground,* and burning the tops three successive seasons, almost completely freed a patch at the station of the disease, which was previously very seriously affected throughout. The practice must be followed up carefully each year where the disease has gotten a start, and the same treatment extended to neighboring patches or plants, should there be such in the vicinity.

In case spraying is deemed desirable, as is the case in some sections, the object must, of course, be prevention rather than cure. This will necessitate beginning promptly, as the summer growth pushes up and following up the treatment thoroughly and repeatedly through the summer. The "resin Bordeaux," having better adhesiveness, is preferable to the ordinary Bordeaux mixture for asparagus.

To Make.—Heat together one pint of fish oil and five pounds of resin on a stove. Cool; then add one pound of soda lye and stir. Next, add five gallons of water and boil thoroughly. The resulting mixture should dissolve readily in cold water. Use at the rate of two gallons to a barrel of the Bordeaux mixture.

PART III.

Rhubarb in Arkansas.

By Ernest Walker, *Horticulturist.*

Maryland is commonly given as about the southern limit of successful rhubarb culture, that is, in anything like a commercial way. The location there gives growers a considerable advantage in the matter of earliness for shipment to more northern localities. During the past four years the crop has been grown in an experimental way at the Arkansas Experiment Station with excellent success.

Unlike asparagus the plant does not thrive in the warmer parts of the state. The idea had become prevalent that it would not succeed even in north Arkansas, hence the plant has received no attention hitherto. R. C. McCollum and Jacob Schlafley, near Fayetteville, have grown the plant in a small way for the past few years and have found it to succeed "quite as well as at the north," while the former considers it relatively the most profitable crop on his place. Owing to the elevation (here some 1,500 feet) the plant will doubtless be found to succeed over much of northern Arkansas where suitable soils are found. The crop is worthy of the attention of those favorably located and with suitable land. It is readily shipped and easily forced. It is hardly a crop for general cultivation on a large scale, but a limited acreage, properly handled, would be found very profitable. Forcing would also pay here since competition with the open-air product of warmer localities would not interfere.

SOIL.

The principal requirement of the crop is a deep, well-enriched, moist but well drained soil, that with a clayey character being preferable. Level land or very slightly inclined to the south or southeast is desirable in this latitude. It should be free from trees, and have an open exposure. The plant is a gross feeder. Deep preparation of soil and liberal manuring, at least after the planting is established and is producing, is therefore of importance. This is always true of plants which push up a heavy luxuriant growth in a short period.

PROPAGATION.

The usual method of obtaining plants is by means of division. The old roots are lifted and cut apart through the crown so that each piece shall have from one to three eyes. The roots, so divided, may be had of most nurserymen northward.

The seed germinate readily and plants may be obtained in this way though it is not so satisfactory for commercial plantings. The resulting plants show much variation as a rule—only about 15 per cent. coming true. New varieties may be obtained in this way. The seeds may be started in a hot bed early in the season and planted out in rows at the usual season. In this way large plants may be had in a single season.

When sown in the open ground the seeds are placed in drills one inch deep, the drills being from one one foot to eighteen inches apart. When the plants appear they are thinned to stand three or four inches apart. A good, well prepared soil should be chosen for the purpose, and good cultivation given subsequently and the rows kept free of weeds. The following spring the young plants are set out in their permanent places. The usual distance between plants allowed being four feet each way, with crowns three to four inches deep. Deeper planting is not desirable. A planting established is allowed to stand four or five years, when the crowns are taken up and divided and a new planting made. The crowns become very large after a few years and the stalks tend to become small. Surplus divided roots may be sold at $6.00 to $12.00 per hundred.

Some growers plow or dig trenches where the rows are to run, placing a few inches of rotted manure in the bottom below the plants, and allow the plants to remain eight to ten years, but this increases the expense and ordinarily the other method is to be preferred.

Under favorable conditions the leaves and stalks grow to enormous size, and at the distances named almost completely shade the ground crowding out weeds. Cultivation, however, should be given one way to keep the soil from becoming hard and dry. No cropping should be allowed till the third year. Each fall there should be a broadcast application of ten to twelve cords of manure. This should be cultivated into the soil, and the ground thoroughly worked over again in the spring. Manure along the rows should be forked under. Cultivation is suspended during the bearing season. Hence the importance of thoroughness in the early working. After the bearing season is past cultivation should be resumed.

Commercial fertilizers cannot replace stable manure in the growing of rhubarb, but may supplement it with profit. Nitrate of soda scattered along either side of the rows in the spring at the rate of 75 to 150 pounds per acre, has been found to be profitable, stimulating growth and hastening the crop when it brings the best prices. Nitrification proceeds slowly in the early spring and owing to the leachiness of nitrates winter rains have usually reduced the available supply for the very early spring crops. Nitrate of soda may be used therefore to a good purpose on various early spring crops, especially herbage crops, for these reasons. For general fertilization, however, for the crop, stable manure is indispensable, supplying, as it does, humus, thus increasing the soils capacity for holding moisture, a condition essential to successful rhubarb culture. It assists especially in carrying the plants through the hot season in good condition.

VARIETIES.

The varieties Linnaeus and Victoria succeed here. The former is the earlier and for this reason the better, as a rule. The latter is very strong and large. It is sometimes used for wine making, and called wine plant. There are several other varieties but they are better adapted for cultivation farther northward.

HARVESTING AND MARKETING.

The leaves are gathered by pulling them off. This operation requires care to avoid unnecessary injury to the young leaves and crowns, and to have the stalks come off at the very base two or three inches below the ground. The leaves are gathered up and taken to a shed where they are tied in bundles, cutting off the leaf proper a couple of inches from the stalk. In forced rhubarb the undeveloped leaf is not removed, its bright yellow color adding to the attractiveness of the bundles. For local market the stalks are cleaned of hulls and washed, but for shipment the stalks are cleaned by simply brushing off the dirt. The stalks are tied at bases and near the tops with ordinary binding twine or raffia, into bunches of three or four stalks, and these again formed into bundles of a dozen bunches. This method is a convenience for the retail merchant. For shipment, these bundles are wrapped in paper and boxed six or more bundles to a box. Again the single stalks are tied neatly at top and base, into bundles of twenty-five to thirty pounds, or loose packed in boxes of about a barrel capacity. Weights are marked on the package or on attached tag at the time. In such matters one must be governed by the requirements of the market. Neatness in packing, and a good article, however, are always in order.

Growers dispose of their crops in various ways—in the local market, to grocers, hotels or private families, or to dealers in more or less distant cities, and commission merchants. Care must be taken that the rhubarb is not frozen in shipment. Express shipment consumes much of the profit but is the only safe way for small quantities.

Common yields are from 16,000 to 20,000 pounds per acre in the open air. The price varies according to the season, market, etc. It seldom brings less than one cent per pound. The forced and early pickings bring the best prices, from five to fifteen cents per pound being frequently realized.

FORCING.

Rhubarb is readily forced, the expensive appliances needed in the case of many other crops when brought in out of season, being wholly unnecessary. The business is carried on to a considerable extent in the neighborhood of many of the large cities of the country. This early product finds a ready market at good prices.

Cold frames, the cellar, or cheap forcing houses may be used for the purpose. Sash and glass are unnecessary as the crop does not require light—warmth and moisture only being needed. For use in forcing only strong well-grown roots two or three years old are used. At the low temperature commonly furnished when the plants are forced in cold frames or cellars, it is important that the roots used shall have been frozen. Here they should be dug with what earth adheres to the roots, and left on the surface of the ground until they have been solidly frozen. They may then be covered with litter or straw to prevent alternate freezing and thawing. They may be forced without freezing in hot beds, or where given higher temperature, but high temperature gives a poor product, a smaller crop and more fully exhausts the roots.

The roots are commonly placed in position for forcing early in February, the time required being from four to six weeks according to the temperature supplied. This varies from 45 to 75 degrees. The best yields and results are obtained at the lower temperature. The roots are packed closely together on the ground or floor of the structure used. The spaces between the roots are filled in with soil. No water is required until growth has started actively. It may then be given freely.

A few roots will provide a supply for early home use, and the same may be easily forced in a corner of the cellar, partitioned or curtained off for convenience in heating. A small coal oil stove or a couple of lanterns will supply warmth. A large dry goods box may answer. The space under the stages of a conservatory or greenhouse may be also used by curtaining or boarding up to exclude light. Ordinarily the temperature in such places is higher than necessary, and the results are not as satisfactory as in a cellar. The roots should not be placed too near the heating pipes. A small box pit in a well drained place on the south side of the house or other buildings may be used. The warmth being supplied by a covering of boards and piling manure about the sides a foot or so thick, and over the top to half that depth. A barrel or box so arranged may be placed over a clump in the garden for supplying a few early stalks.

For forcing on a larger scale a good sized cellar or a cheap building made for the purpose may be used, the heat being supplied by a flue, a stove, or in case of a permanent structure by means of steam or water pipes. A shed or large cold frame built of rough boards covered with building paper and roofed over the same way or with sash, may be used for the purpose. It need not be over five feet high at the sides, the width and length being according to convenience. The walls may be lower provided walks are sunken a foot or more deep through the length of the shed. The heat may be supplied by means of a flue or a stove in case the structure is of moderate size, placing the stove and the pipe so as to secure as uniform distribution of the heat as possible. It will be desirable to have the stove stand in a small vertical walled pit with ample space about the sides and let the pipe in passing outward to the end of the house and chimney run neither close to the roof nor to the ground. Placing the stove in the pit secures a better circulation of the air in the house and more uniform heating. The ordinary King or Wilson (sheet iron) heater, with the opening in the top, is well suited for the purpose of heating a moderate sized shed or pit. A damper in the pipe near the outlet, together with that on the stove, gives a very fair control of the heating after a little experience.

In general the arrangement here described is well suited to the needs of those having a small conservatory or pit to be heated. The heating of such without too much care and expense has always been a problem. The plan here suggested was devised by the writer and has been used for some years, giving great satisfaction. When not in use the heater is removed from the pit and stored. If left in the pit it rusts out in the course of about two seasons.

Having the general idea as to forcing rhubarb it is an easy matter to adjust the details according to the requirements of the operator. In some cases rather compact permanent plantings are made in the soil and the house built over them, giving the plants open culture during summer by removing the sash or other covering. Sometimes half the house being forced one year, the rest the next.

Forced rhubarb is very attractive in appearance. The stalks grown in the dark assume a very bright, crimson color. The leaf blades remain small and undeveloped, taking on a bright yellow. The quality is also very superior, having a delicacy not found in the open air product. Forced rhubarb brings from eight to fifteen cents per pound.

The roots, if not too highly forced, may be used for division and planting out. They regain their vigor after two or three seasons, with good care. A supply of roots must be kept coming on when forcing is regularly undertaken. Seedlings and divided roots may be rendered suitable for use earlier by liberal manuring and high cultivation.

Fertilizers Registered for Sale in Arkansas During 1905.

A. M. MUCKENFUSS, State Fertilizer Chemist.

"Found" signifies "Found by Analysis."
"Guaranteed" signifies "Guaranteed by the Manufacturer."

Name of Manufacturer, Location and Brand.	Per Cent of Nitrogen Calculated as Ammonia.	Per Cent of Potash K_2O	Per Cent of Phosphoric Acid P_2O_5			
			Available.	Soluble.	Reverted.	Insoluble.
Armour Fertilizer Works, Chicago, Ill., E. St. Louis, Ill., Omaha, Neb., Nashville, Tenn.						
386—						
Guaranteed	3.0	6.0	8.0	6.0	2.0	2.0
Found	3.57	6.11	8.98	7.6	1.38	1.27
Raw Bone—						Total
Guaranteed	4.5	.....	.....	.....	.....	22.0
Found	5.3	.....	.....	.....	.....	24.0
Bone Meal—						Total
Guaranteed	3.0	.....	.....	.....	.....	24.0
Found	5.4	.....	.....	.....	.....	27.8
King Cotton—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	2.0
Found	2.4	2.53	10.0	9.25	0.75	1.0
Phosphate and Potash—						
Guaranteed	.....	2.0	10.0	6.0	4.0	2.0
Found	.....	2.32	12.1	11.95	0.15	0.4
Star Phosphate—						
Guaranteed	.....	.....	14.0	11.0	3.0	2.0
Found	.....	.....	16.7	14.35	2.35	0.8
Corn and Cotton—						
Guaranteed	1.0	1.0	8.0	6.0	2.0	2.0
Found	1.7	1.06	10.05	8.1	1.95	1.4
Meridian Fertilizer Factory, Meridian, Miss.						
Meridian Home Mixture—						
Guaranteed	2.0	1.5	9.5	8.0	1.5	1.0
Found	2.25	1.6	10.1	8.0	2.1	1.6
Meridian Vegetable Grower—						
Guaranteed	3.0	6.0	6.0	5.0	1.0	1.0
Found	3.9	7.79	8.76	6.9	1.86	0.44
Meridian Blood and Bone—						
Guaranteed	2.0	1.5	9.5	8.0	1.5	1.0
Found	2.8	1.56	10.58	7.67	2.91	3.12
Meridian Southern Acid Phosphate—						
Guaranteed	.....	.....	14.0	12.0	2.0	1.0
Found	.....	.....	15.37	12.0	3.37	1.03

Name of Manufacturer, Location and Brand.	Per Cent of Nitrogen Calculated as Ammonia.	Per Cent of Potash K_2O	Per Cent of Phosphoric Acid P_2O_5			
			Available.	Soluble.	Reverted.	Insoluble.
Caddo Fertilizer & Oil Co., Shreveport, La.						
Caddo Cotton—						
Guaranteed	2.5	1.0	8.0	6.0	2.0	1.0
Found	2.53	1.38	9.78	5.88	3.9	0.72
Corn and Vegetable—						
Guaranteed	3.5	1.0	6.0	4.0	2.0	1.0
Found	3.7	1.59	6.12	4.07	2.05	1.58
Crown—						
Guaranteed	2.0	1.0	9.0	7.0	2.0	1.0
Found	2.34	1.72	9.9	6.7	3.2	2.05
Star—						
Guaranteed	2.0	1.5	10.0	8.0	2.0	1.0
Found	2.53	1.61	12.02	7.7	4.32	0.98
Caddo Special—						
Guaranteed	3.0	7.0	6.0	4.0	2.0	1.0
Found	3.05	7.8	7.92	4.88	3.04	0.73
New Orleans Acid & Fertilizer Co., New Orleans, La.						
Black Diamond Acid Phosphate—						
Guaranteed	.....	.....	12.0	10.0	2.0	3.0
Found	.....	.....	12.2	9.57	2.63	2.0
Crescent City Acid Phosphate—						
Guaranteed	.....	.....	12.0	10.0	2.0	3.0
Found	.....	.....	12.58	11.93	0.63	2.07
Blood, Bone, and Potash—						
Guaranteed	1.65	1.0	9.5	7.0	2.5	3.0
Found	2.1	1.02	10.55	7.7	2.85	1.3
Pure Gold—						
Guaranteed	1.65	1.0	9.5	7.0	2.5	3.0
Found	2.52	1.83	10.95	7.1	3.85	1.75
Gold Dust—						
Guaranteed	1.65	1.0	9.5	7.0	2.5	3.0
Found	2.29	1.28	11.85	7.8	4.05	0.85
Goldsmith's Improved Mixture—						
Guaranteed	1.65	1.0	9.5	7.0	2.5	3.0
Found	2.4	1.88	11.7	8.15	2.55	0.9
Blood, Bone, and Beef—						
Guaranteed	1.65	1.0	9.5	7.0	2.5	3.0
Found	2.11	1.27	11.8	7.6	4.2	0.7
Jackson Fertilizer Co., Jackson, Miss.						
High Grade Acid Phosphate—						
Guaranteed	.....	.....	14.0	12.0	2.0	1.0
Found	.....	.....	17.0	16.50	0.5	2.5
Royal C Brand—						
Guaranteed	1.65	1.8	9.5	7.0	2.5	1.0
Found	2.1	2.5	11.8	9.9	1.9	1.4
Mayer Fertilizer and Junk Co., St. Louis, Mo.						
Anchor Brand Complete Fertilizer—						
Guaranteed	2.5	2.0	10.0	.....	.....	4.0
Found	2.5	2.5	10.0	6.45	3.45	5.3
Anchor Brand Acid Phosphate—						
Guaranteed	.....	.....	14.0	.....	.....	1.0
Found	.....	.....	14.52	10.25	4.27	1.9

Name of Manufacturer, Location and Brand.	Per Cent of Nitrogen Calculated as Ammonia.	Per Cent of Potash K_2O	Per Cent of Phosphoric Acid P_2O_5			
			Available.	Soluble.	Reverted.	Insoluble.
Anchor Brand Special Truck Grower—						
Guaranteed	3.0	4.0	8.0	.....	.....	3.0
Found	3.00	3.21	8.0	4.7	3.3	3.6
Anchor Brand Bone and Potash—						
Guaranteed	2.0	1.5	8.0	.....	.....	3.0
Found	2.2	1.63	8.0	5.1	2.9	4.7
Arkansas Fertilizer Co., Little Rock, Ark.						
White Diamond Twentieth Century Fertilizer—						
Guaranteed	2.0	1.5	10.0	.....	.....	4.0
Found	2.0	1.69	10.5	6.5	4.0	3.9
White Diamond Kali-superphosphate—						
Guaranteed	.....	2.5	11.5	.....	.....	1.0
Found	.....	2.34	11.5	6.4	5.1	2.2
White Diamond Acid Phosphate—						
Guaranteed	.....	.....	14.0	.....	.....	1.0
Found	.....	.....	14.0	10.1	3.9	2.7
White Diamond Ammoniated Bone Superphosphate—						
Guaranteed	2.5	2.0	9.0	.....	.....	4.0
Found	2.53	2.00	9.5	6.4	3.1	5.8
White Diamond Nitrated Superphosphate with Potash—						
Guaranteed	3.0	3.3	8.0	.....	.....	3.0
Found	3.2	3.3	8.1	6.1	2.0	4.8
Standard Guano and Chem. Mfg. Co., New Orleans, La.						
Sterns Ammoniated R. B. Superphosphate—						
Guaranteed	2.0	1.0	9.5	7.0	2.5	1.0
Found	2.2	1.2	9.8	7.5	2.3	2.5
Champion Farmers Choice—						
Guaranteed	2.0	1.0	9.5	7.0	2.5	1.0
Found	2.5	1.7	10.4	9.6	0.8	2.9
Acid Phosphate—						
Guaranteed	.....	.....	14.0	12.0	2.0	2.0
Found	.....	.....	15.7	13.5	2.2	2.7
Kainit—						
Guaranteed	.....	12.0	.....	.....	.....	.....
Found	.....	14.1	.....	.....	.....	.....
Mississippi Home Guano—						
Guaranteed	2.0	1.0	9.5	7.0	2.5	1.0
Found	2.6	1.5	9.9	9.0	0.9	2.2
Capital Fertilizer and Mfg. Co., Jackson, Miss.						
Standard Nonpareil—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	2.0
Found	2.3	2.3	9.2	8.3	0.9	1.3
High Grade Acid Phosphate—						
Guaranteed	.....	.....	12.0	10.0	2.0	2.0
Found	.....	.....	13.6	10.8	2.8	0.7
Vegetable Grower—						
Guaranteed	2.5	4.0	6.0	.....	.....	.....
Found	3.6	4.9	7.1	6.3	0.8	0.6

Name of Manufacturer, Location and Brand.	Per Cent of Nitrogen Calculated as Ammonia.	Per Cent of Potash K_2O	Per Cent of Phosphoric Acid P_2O_5			
			Available.	Soluble.	Reverted.	Insoluble.
Red Star—						
Guaranteed	1.65	2.25	8.0	.....	.....	.....
Found	2.0	2.34	10.07	8.19	1.88	0.82
Virginia-Carolina Chemical Co., Memphis, Tenn.						
Mobile Standard Guano—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0
Found	2.2	2.0	10.1	6.6	3.5	2.0
Royal Vegetable Fertilizer—						
Guaranteed	3.0	4.0	8.0	6.0	2.0	3.0
Found	3.68	4.27	10.2	7.8	2.4	2.6
Royal Compound—						
Guaranteed	.....	2.0	10.0	8.0	2.0	3.0
Found	.....	2.18	10.1	3.2	6.9	2.4
Scotts' High Grade Acid Phosphate—						
Guaranteed	.....	.....	14.0	12.0	2.0	3.0
Found	.....	.....	15.5	9.3	6.2	2.3
Royal Acid Phosphate—						
Guaranteed	.....	.....	12.0	10.0	2.0	3.0
Found	.....	.....	12.3	2.7	9.6	2.7
Mobile Acid Phosphate—						
Guaranteed	.....	.....	12.0	9.0	3.0	3.0
Found	.....	.....	12.0	8.2	3.8	3.4
German Kainit—						
Guaranteed	.....	12.0	.....	.....	.....	.....
Found	.....	12.8	.....	.....	.....	.....
Royal Cotton Boll Guano—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0
Found	2.2	2.0	9.6	7.6	2.0	1.9
Scott's State Standard Guano—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0
Found	2.3	2.88	8.2	6.5	1.7	1.6
Scott's Ammoniated Bone—						
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0
Found	2.4	1.52	11.2	7.2	4.0	0.9
Royal Animal Bone Guano—						
Guaranteed	2.0	1.0	9.0	7.0	2.0	3.0
Found	2.21	1.25	11.8	7.5	4.3	2.4
Scott's Gossypium Phospho—						
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0
Found	2.3	2.51	10.48	7.0	3.48	2.12
Royal High Grade Guano—						
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0
Found	2.17	1.95	12.4	8.55	3.85	2.3
Royal Blood, Bone, and Potash—						
Gauranteed	2.0	1.5	10.0	8.0	2.0	3.0
Found	2.15	2.13	11.6	8.17	3.43	2.9
Royal Potash Compound—						
Guaranteed	.....	4.0	10.0	8.0	2.0	3.0
Found	.....	4.2	11.9	9.2	2.7	2.7
V. C. Co.'s Truck Grower—						
Guaranteed	2.5	6.0	8.0	6.0	2.0	3.0
Found	2.5	6.8	9.4	5.9	3.5	1.5
Mobile Double Eagle Guano—						
Guaranteed	2.0	1.5	10.0	8.0	2.0	3.0
Found	2.3	2.7	11.8	8.8	3.0	1.9

Name of Manufacturer, Location and Brand.	Per Cent of Nitrogen Calculated as Ammonia.	Per Cent of Potash K_2O	Per Cent of Phosphoric Acid P_2O_5			
			Available.	Soluble.	Reverted.	Insoluble.
Southern Cotton Oil Co., Memphis, Tenn., Little Rock, Ark.						
Southern C. O. Co.'s Early Truck Grower—						
Guaranteed	3.0	4.0	7.75	5.75	2.0	3.0
Found	3.2	4.23	8.1	6.6	1.5	2.2
Southern C. O. Co.'s Soluble Guano—						
Guaranteed	2.0	2.0	8.0	6.0	2.0	3.0
Found	2.4	2.24	8.8	5.9	2.9	1.5
Southern C. O. Co.'s Acid Phosphate—						
Guaranteed	.....	.....	14.0	12.0	2.0	3.0
Found	.....	.....	15.5	10.7	4.8	2.3
Swift & Company, Chicago, Ill., Kansas City, Kan., East St. Louis, Ill., Ft. Worth, Tex.						
Special Vegetable Fertilizer—						
Guaranteed	2.5	6.0	8.0	.....	.....	2.0
Found	2.8	6.46	11.7	6.8	4.9	1.1
Champion Vegetable Grower—						
Guaranteed	3.0	4.0	8.0	.....	.....	2.0
Found	4.6	3.22	11.0	7.4	3.6	1.3
Superphosphate—						
Guaranteed	2.0	2.0	8.0	.....	.....	4.0
Found	2.7	2.05	11.2	7.5	3.7	2.3
Columbia Cotton Oil Co., Magnolia, Ark.						
Magnolia Fertilizer—						
Guaranteed	2.2	1.7	8.6	.....	.....	.....
Found	2.7	1.94	9.65	7.0	2.65	1.35
P. B. Mathiason Mfg. Co., St. Louis, Mo.						
Increscent Brand Southern Special—						
Guaranteed	3.0	2.0	9.0	.....	.....	3.0
Found	3.1	2.25	9.4	4.4	5.0	5.3
Arkansas Special Cotton and Corn Grower—						
Guaranteed	2.0	1.5	8.0	.....	.....	2.0
Found	2.06	1.74	10.7	4.3	6.4	5.9
Increscent Brand Pure Bone Meal—						Tota
Guaranteed	3.25	.....	.....	.....	.....	23.0
Found	4.08	.....	.....	.....	.....	23.9
Globe Fertilizer Co., Louisville, Ky.						
Eagle Corn and Wheat Grower —						
Guaranteed	1.65	2.0	8.0	.....	.....	.....
Found	1.99	2.0	10.0	7.02	2.98	3.05
Potash Special—						
Guaranteed	.....	2.0	10.0	.....	.....	.....
Found	.....	2.14	10.71	8.19	2.52	2.35

Glanders of Horses.

R. R. Dinwiddie.

Since July 1st, 1903, when funds became available for the purpose, this Division of the Experiment Station has, in an unofficial way, undertaken the work of inspection and control of contagious stock diseases, what is usually designated State Veterinary or Live Stock Sanitary work. This work consists in examining into outbreaks of disease in live stock when requested or when such outbreaks are reported here, diagnosing or determining the nature of the disease and advising such means of control as seem necessary or as the law prescribes.

The demand for this line of work and its appreciation by the farmers and stockmen have been unmistakable. The necessity for its continuance and extension is not only evident but it is urgent.

The principal communicable diseases which have been met with, are Glanders in horses and mules, Texas Fever and Blackleg in cattle. On account of the serious losses arising from the prevalence of Glanders in the State, and the fact that it can be controlled only by an official Veterinary service, acting along with the intelligent cooperation of the stock owners, it is desirable that farmers and stockmen generally should be better informed in regard to this disease and the measures necessary for its eradication or control. This information we try to supply here with the hope that those who receive and read this (and other agricultural literature from the Experiment Station) will consider it their duty to act as centres of enlightenment to others less fortunate.

NATURE, CAUSES AND SYMPTONS:

By name at least Glanders is known to all who have to do with horses as a dreaded and incurable disease. It is recognized in all civilized countries as one of those diseases which have to be controlled by the "stamping out" process which, in the case of animals, means slaughter, isolation and disinfection.

The germ or bacillus which occasions it becomes localized chiefly in the lung, the upper respiratory passages—nasal and facial cavities—and in the skin. In each of these situations it gives rise first, to inflammatory nodules which later break down into corroding ulcers. Along with this is involvement of the lymph glandular system. The tendency of the disease is progressive, the ulcers extending and increasing in numbers; the general condition becomes impaired; and death ultimately ensues from an acute aggravation, from some sequel or complication, or from chronic inanition.

Glanders originates by contagion; that is, by contact of a diseased animal with others which are healthy. Most commonly a newly purchased animal in which the disease was not recognized at the time is the cause of the trouble. The discharge from the nose or from ulcers of the skin contains the infectious matter or *virus* and contact of a sound horse with this material is sufficient to beget infection, hence, *direct* contact of one animal with another is not necessary to the spread of the disease.

Besides direct contact, as by smelling or "nosing" each other the infection is commonly due to smearing of the discharges on mangers, drinking troughs, fodder racks, or even on lot fences or the end of wagon poles. Harness, also, which has been worn by a glandered horse is dangerous for others until disinfected, especially if the disease has shown the form of *farcy* or glanders involving the skin.

An important question often asked is how long a stable which has contained glandered horses remains infectious for others after the diseased animal is removed. This question does not admit of a positive answer which will apply to all cases. The infectious material is quickly destroyed by exposure to dry air and sunlight—within a few days if in thin smearing only, but longer if in thicker masses. In the shade and where protected from rapid drying the time is much longer. An infected stable is said to be unsafe within a period of four months, and quite frequently six months vacancy is recommended by veterinary writers. The period can be greatly shortened by proper cleansing and disinfection such as described later.

The infection is not conveyed to any distance through the air and never assumes an epidemic form like influenza or distemper. It is always spread by immediate contact with another diseased animal or with its discharges.

Glanders may occur in different degrees of severity. Sometimes it is very chronic and for a long time but few symptoms are shown, nothing perhaps but a slight nasal discharge which may even be intermittent. These cases are the most dangerous of all since they do not arouse suspicion while the disease which they spread is as virulent as that spread by severe cases.

The severity of a case of glanders seems to depend chiefly on the susceptibility of the animal. It is also greatly influenced by the way in which the stock are kept. Hardships in the way of food, shelter or work tend to aggravate the trouble and bring on an actute attack. Temporary exposure to cold rains has often been noticed to cause acute and fatal glanders in stock which previously showed no symptoms of ill health recognized by the owner. These conditions along with another no less important where it exists; namely, imperfect ventilation of stables, are contributory causes which may initiate the disease or aggravate it but only when the essential cause or contagion exists.

Glanders though inoculable to other species is essentially a disease of the horse tribe,—horses, mules and asses.

SYMPTOMS:

These will vary according to the severity of the disease—whether chronic or acute glanders or farcy.

The chronic form is the most common and also often the hardest to recognize with certainty. In this form the symptom which will usually be first noticed is the nasal discharge. There is nothing quite characteristic about the snot of glanders by which it can be distinguished from an ordinary catarrhal flow. It has, however, certain features which should excite suspicion. In glanders the discharge is sometimes from one nostril only. At first thin and watery, it becomes later thicker and yellowish, but may change in character and quantity at different times. It may even cease entirely for a time. The color may be greenish and occasionally streaked with blood which is unusual in other diseases. It is generally extremely sticky and adheres around the nostrils, a symptom that experts always look for. In old cases the discharge may be extremely abundant and most offensive, but in many cases which run a mild course it is odorless and so scanty as to escape observation. Such cases are the most dangerous to other stock because unsuspected.

Glandular Enlargements. This is an important symptom which should always be looked for. The lymph nodes under the skin which are hardly perceptible in health, enlarge in the regions where the disease is located. Hence, in ordinary cases involving the nasal chambers one or both of the glands under the jaw will be swollen. They are located between the branches of the lower jaw, one on either side. The swelling may be soft at first but later becomes hard and nodular and closely attached to the bone.

Tubercles, nodules and ulcers form in succession in the membrane lining the nostrils and cavities of the face. These in pronounced cases can be seen by careful inspection within the nostrils. Ulcers, especially, can be recognized by any one who looks for them when they are present and low down in the nostrils. These are really the most characteristic symptoms of glanders, but unfortunately are often, in the earlier stages, either absent or located high up and out of sight.

Other symptoms which may or may not be present are discharge from one eye, cough, lack of sleekness of coat, shortness of wind and general lack of vigor. Examination may also reveal farcy buds, or ulcers along the inner face of the limbs, or on other parts of the body.

Farcy buds are small lumps or knots which form beneath the skin in connection with the lymphatic system. They tend to soften and break down into sores, discharging an oily looking, sticky fluid, and with little tendency to heal. Passing from these may be felt the hard, or corded lymph vessels. Swelling of a hind limb or joint often occurs quite suddenly ushering in an aggravation of the disease. These skin manifestations are usually designated "Farcy" but they are quite often conjoined with the disease of the nasal and respiratory tract.

Acute glanders may originate directly from first infection or may supervene on the chronic form. It begins with chills or rigors and high fever, and may end fatally in a few days. A case recently seen illustrates this form. The stable became infected by an old chronic case introduced some months before, and this animal after disseminating the disease throughout a large stable and in the surrounding country, causing the death naturally or by slaughter of many valuable horses, was still in a thrifty looking condition itself but for the typicaal nasal lesions. The horse in question was taken with rigors, or shivering, followed by high fever and stiffness. When seen, there was swelling and puffiness of the face, hot painful swelling of one hind limb, along the inner face of which were a number of small sores oozing a thin, reddish, yellow fluid. The nostrils were dripping a reddish serum and their lining membrane dark, almost black, and roughened with small tubercles and ulcers. Glands under the jaw large, soft and painful. Eyes swollen and dripping the same kind of fluid. Several others had died in the previous ten days with similar symptoms and on inquiry it was found that they had been exposed to unusually rigorous weather, cold and wet. Several cases of chronic glanders were found in the same stable. *The fatal cases were aggravations of the ordinary chronic form, induced by exposure.*

DIAGNOSIS.

The farmer or stockman will not generally be able to diagnose this disease with certainty himself, although in well marked cases he can do so; but he can, from this description, know what cases are suspicious of glanders and call for expert examination. This is as much as we hope for in issuing this bulletin and if so much is accomplished the main difficulty in eradicating or controlling the disease will be overcome.

There are some other diseases from which it has to be distinguished. At times the distinction is not difficult but in other cases even an expert may be deceived.

Distemper (or strangles) is accompanied by cough and nasal discharge but the characteristic feature here is an abscess in the mid line at the throat which soon softens and ruptures, and this is followed by recovery. *Influenza* or Pinkeye, catarrh of the head, and diseased upper molar teeth may also simulate glanders. None of these, however, show the ulceration of the nasal mucous membrane peculiar to glanders.

In all cases of discharge from the nose, with swollen glands on either side under the jaw, and especially if more than one animal is similarly affected, indicating a contagion, the owner should at once obtain expert advice if possible. If properly trained veterinarians are not within reach, and this is the case generally in this State, it is better to rely upon his own judgment than on that of the untrained local wiseacre in stock diseases, whose advice we have generally found to be not only ignorant, but in the case of contagious diseases positively harmful. In more than one of the most serious outbreaks of glanders investigated during the past year, the owners had been deceived even against their own judgment by the confident assertion of some so-called "horse doctor" and suffered serious losses in consequence.

It is the intention of this Department to appoint or accredit a number of veterinarians in different parts of the State, where trained men can be found, who can be reliably consulted by those who suspect the existence of contagious diseases in their stock. Further reference to this matter will be made further on in this report.

THE DISEASE IN MAN.

This is not very frequent. When it does occur it is practically always due to infection from the horse, inoculation occurring by the matter from the nostrils or skin ulcers getting into sores on the hand and fingers, into the nose by transference from soiled fingers, or into the eyes when examining a snorting horse. All of these sources of infection should be carefully guarded against by those handling diseased horses, as glanders in the human is no less loathesome and fatal than in the horse.

TREATMENT.

Little need be said under this head. It is not a disease which calls for curative treatment, although it is believed that complete recoveries occasionally occur. As in the case of tuberculosis of cattle the unstabled, open-air life of the western and southern ranges affords the best conditions for resisting the disease both in its initiation and course. These favorable conditions, however, are often counterbalanced by the hardships of insufficient food and severity of climate, so that western horses shipped into this State are quite commonly affected with glanders and form one of the main sources of infection for our native stock. Curative treatment when attempted has never been sufficiently successful to off-set the expense and risk of infecting other stock, and is now never recommended by those who have any real knowledge of veterinary pathology. Stock owners are therefore warned against those voluble pretenders who undertake to cure animals which have been officially condemned as glandered.

PREVENTION.

This is the aim of live stock sanitary work and is accomplished by the usual methods employed in combatting contagious diseases, isolation and disinfection, combined in this instance with what is most important of all, slaughter of diseased animals. In the control of glanders it is necessary first of all to make a sure diagnosis in those animals showing recognizable symptoms. This can be done by any veterinarian who has been fitted for his business, by training, study and experience, and may sometimes be done by the owner by carefully studying the above described symptoms. When glanders has been detected in a stable there will usually be cases in which the disease is little developed and visible symptoms are either lacking or too slight for any certainty in diagnosis. Such cases will develop later and keep up the disease after it is thought to have been gotten rid of.

DIAGNOSIS BY MALLEIN.

Mallein is a test reagent for the detection of obscure cases of glanders, which is now used by all live stock inspectors, and is indeed, so essential that no veterinarian who knows his business would undertake to eradicate or control an outbreak of this disease without it. The material, which is a product of the artificial growth of the glanders germ, is injected beneath the skin of the animal to be tested, and the decision on the case is reached by observing the effects produced; in the healthy animal these are slight, or absent, but in the glandered animal a fever and large local swelling results. Usually this test will have to be made by veterinarians, although it may be done by others by carefully following directions.

After all diseased animals have been thus discovered, those which show visible symptoms should be destroyed. Others detected only by this test may also be slaughtered and this course is usually followed where State compensation is allowed. Where the owner objects to this, as he usually does, it is customary to class these as suspicious cases, to be kept isolated and under observation to be retested later, or until visible signs of disease are present. Complete cleansing and disinfection of all fixtures or articles which may have been smeared with the discharges must be carried out. The disinfectant commonly used is corosive sublimate, one part to one thousand. Stables, in addition, should be whitewashed and, whenever possible, left unoccupied and open to sunshine for a lengthy period—four months is sometimes named—but the length of time will depend on the thoroughness of the disinfection and cleansing. If thorough, one week or less might be sufficient.

All animals which have been exposed to glandered stock should be kept under careful observation for some time. Mallein testing of all exposed animals, although theoretically correct, is practically a task of too much magnitude to be generally adopted.

OFFICIAL INSPECTION.

It will be evident from what has been said above that the control of this disease can only be effectively carried out by official inspection, supported by State laws. Most states and countries where the live stock industry is of any importance have adopted this plan. The essentials of this live stock sanitary service are, (1) efficient veterinary service, supplied by the State directly or indirectly; (2) Laws prohibiting the introduction, driving, trading in, or even keeping of glandered stock; and, (3) A board, committee, or official whose duty it is to see to the enforcement of these laws. This last provision is the most important of all. In Arkansas a law has existed for years on the statute books, intended to prevent the introduction and spread of glanders, but nobody has ever heard of even one instance where it has been enforced, although the opportunities for its enforcement may be found in perhaps every county in the State.

The laws of Arkansas dealing with contagious diseases of animals have been given in a previous report (Bulletin 82) which will be sent on application. This contains a copy of the Act of 1897, prohibiting the introduction of diseased stock. The legislature this year (1905) enacted in Senate Bill 148, some further legislation on the subject which reads as follows:

"Section 5. If the veterinarian, or his assistants, should after making a thorough diagnosis of the diseased or infected stock, find that they are infected with contagious or incurable diseases, he shall direct the owner or owners, or their legal representatives to kill and burn such diseased stock. Should the owner refuse or neglect to kill and burn such diseased stock that has been found incurable, and the disease contagious, he shall be guilty of a misdemeanor, and upon conviction before any Justice of the Peace or on indictment, he shall be fined in any sum not more than fifty ($50) dollars, and each day he so neglects or refuses shall constitute a separate offense; he shall also be held liable for all proximate damages sustained by others by reason of the spread of the disease because of his failure or refusal to kill and burn such diseased stock when so directed as provided for in the Act."

The duty of furthering the enforcement of the live stock sanitary laws has thus been placed on the Veterinary Division of the Agricultural Experiment Station. It is the purpose of this Division to act in cooperation with live stock owners so that the prescribed regulations shall be complied with voluntarily, and not under compulsion, but when compulsion is needed it will be obtained and applied impartially.

RULES AND REGULATIONS.

To facilitate the eradication or control of glanders, already far too prevalent in the State by reason of inefficient laws and lack of enforcement in the past, attention is directed to the following rules which all stock owners should carefully read and observe:

(1) *Notification.* Horses or mules showing symptoms, such as described, should be regarded as suspicious of glanders, and information of same at once sent to the Veterinary Division, Agricultural Experiment Station, Fayetteville, Arkansas, giving full description and name of owners;

(2) *Isolation.* After notification from this Department the owner of such suspected animals will be required to guard against further infection until a complete inspection and diagnosis has been made.

(3) *Trading or Selling.* All selling, or trading of such suspected stock, after notification, will be regarded as an attempt to evade the law.

(4) *Opposition* to examination by any accredited inspector or concealment of suspected animals, will call for legal interference at once.

(5) *Diagnosis.* No animals will be condemned as glandered unless the diagnosis is certain, but the inspector's judgment in any case will be final.

(6) *Mallein Test.* The Mallein test will be applied whenever the inspector deems it necessary, but no animal will be condemned (for slaughter) by this test alone, when all other symptoms are lacking.

(7) *Doubtful Cases.* Animals which, after examination, are classed as doubtful must be kept isolated until further observation and tests enable a diagnosis to be reached.

(8) *Disinfection.* The work of slaughter, burning and disinfection has to be done by the owner, but the inspector will advise as to disinfecting matters and if necessary supervise it.

PREVALENCE OF GLANDERS IN ARKANSAS.

This disease being a strictly contagious one does not occur as an epidemic, but rather in isolated groups of cases wherever a diseased animal has carried the contagion. Since no prohibitory laws have ever been in force here the State has been a dumping ground for glandered stock from the large cities around, where such diseased animals are always to be found and are sold at a low price to traders and shippers. The outbreaks we have so far investigated have originated mostly by shipment from Memphis or Kansas City; by shipment of car lots of western horses, or by traveling horse traders and Gypsies.

Glandered horses are generally soon traded off and in every fresh locality disseminate infection. A locality in which a number of horses or mules are thus infected remains infected since the disease does not die out, but is perpetuated by fresh victims from time to time. Our inspection work, practically of one year's duration, has been almost confined to the towns where, on account of closer contact, the disease spreads faster and attracts more attention than in the country. It may be safely said, however, that wherever cases of glanders have been found in town others undetected exist in the surrounding country. So far we have not had the time nor authority to investigate further than on request, and may assume that only a small fraction of the outbreaks of this disease occurring in the State has ever been reported to us. This is shown by the progressive increase in the number of calls for inspection, as this veterinary service becomes wider known. Practically all diseases of horses and mules, of which investigation has been requested, have proved to be cases of glanders. The prevalence of the disease and character of this veterinary service can best be understood from the detailed report of the Inspector in charge of this work herein appended.

Veterinary Inspection for Glanders.

J. F. STANFORD, *Assistant.**

January 10, 1904, was the first date on which a call for inspection of horses was made,—Charles McKinzie, Hazen, Prairie County. Mr. McKinzie had three horses which gave a positive reaction to mallein. One of his horses had been sick for six months. There were no farcy symptoms in any of them. All of them had a nasal discharge and enlarged glands. H. H. McKinzie had a gray mare with chronic glanders. The disease was brought to McKinzie's place by horse traders, who were allowed to camp and ply their business on a vacant lot near Mr. McKinzie's barn, and were also allowed to carry water from Mr. McKinzie's pump to their horses.

About the first of October 1904, a call was madae by Love Banks Co., at Smithdale, Cross County, Ark. He stated that his mules were dying from some contagious disease which was called glanders by some of his neighbors. He wanted to know the law as to the proper disposal of glandered stock. Inspection was begun on his stock on the 13th of October, 1904. A young mule found running on his pasture was suffering from an acute attack of farcy-glanders. A black mule was just beginning to show symptoms of farcy-glanders. It had a very slight discharge from nostrils, left hind leg was swollen, farcy buds just beginning to make their appearance. This mule was tested and the temperature after injection reached 105.1 with a good local reaction. A roan mare on this farm showed enlarged submaxillary glands and small tubercles in nostrils. She was also tested and showed a temperature of 104.6 after injection, and exceedingly good local mallein reaction. It was decided to test all of the remaining stock on the farm, which numbered twenty-three head, eight of which proved to be glandered, all giving good thermometric reaction.

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*Most of the inspection work has been performed by J. F. Stanford, acting under the direction and supervision of the head of this division.

Including those mentioned above, there were eleven diseased out of the twenty-six all of which were tested. The barn, harness, wagons, poles, breast yokes, etc., were ordered disinfected with a 1 to 1000 bichloride solution. The work of disinfecting on this farm, which consisted of 1000 acres, was a very hard one since the stock were scattered out over the place and in care of the land attendants, who were principally all negroes, each renter having a small shed for his mule. It was advised that all of these sheds be burned where they stood. It could not be ascertained definitely where the disease was brought from. Most all of the mules were purchased from a sale stable in Memphis, Tenn. Mr. W. L. Banks says that he traded for a mule which had a discharge from the nostrils and which he thought was suffering from distemper. He traded with Mr. R. G. Block, at Wynne, Cross Co. Mr. Banks says that the mule which he thought had the distemper when he traded for him, afterwards broke out with sores over his legs and different parts of his body. The Inspector did not get to see this mule for it had died or was destroyed before he arrived.

May 11, 1905, we received a letter from Love Banks Co. stating that "real glanders" had developed in a young mule which he had purchased in the latter part of the winter from Memphis. On account of so much work on hand the Inspector could not go to this call until the 20th of May. At this date an examination of this mule was made. There were no plain symptoms of glanders manifested but it was decided to test this mule along with seven others. An undoubted reaction was shown in this mule and a doubtful reaction in two others. It was not thought necessary to test other mules on the farm for Mr. W. L. Banks stated that they were in no way exposed to the one which had the nasal discharge, the one that he thought had the "real glanders."

November 11, 1904, the Director of the Station received a letter from the Fort Smith Lumber Company, stating that there was a disease among their horses and mules and that two local veterinarians out of Ft. Smith had disagreed in their diagnosis; one stating that it was glanders and the other that it was only a slight cold. On the night of December 4th the Inspector from the Station arrived at Abbott, Scott Co., the place where the stock were kept. He examined the five head of horses and mules, two of which were condmned as glandered and tests were made on two others, one of which gave a good reaction and was condemned, the other, a white mare, was considered doubtful from test. The fifth, a mule, had been tested by the planing mill foreman only a few days before and it was useless to make another test in so short a time. This mule was condemned, all symptoms being present to indicate glanders.

About November 11, 1904, a call came from Foreman, Little River Co., that there was a disease prevailing there among the mules belonging to a Mr. Anderson, which baffled all the local authorities in stock discases. Two mules were reported to have died and two others were apparently suffering from the same disease. This was the report made to the Inspector on his arrival at Foreman. The Inspector found the citizens near the home of Mr. Anderson to be very much excited over the outbreak of disease among the animals, and they were making preparation to have some action taken by the township officers. In company with Mr. Anderson, the Inspector was driven out to old Rocky Comfort, where one mule was found to be suffering from an acute attack of farcy-glanders. Ulcers had completely eaten through the nasal septum, uniting the two nasal chambers. The legs and lips were a mass of farcy buds and ulcers. The second mule was apparently suffering from a chronic attack. All the symptoms of glanders were not present. He was tested and a good reaction was obtained. The animals were both killed and buried. Mr. J. S. Anderson, the father of the young man who lost the above animals, was advised to have all his stock that were exposed to the glandered mules tested, to which he consented after an explanation was made to him. There were five head of mules and one horse and one mare of Mr. J. S. Anderson tested. The result of this test was a doubtful reaction in two mules and other three mules and horse and mare gave no reaction. Mr. Anderson was advised to separate the two mules that gave the doubtful reaction and have them tested later. He was also advised to disinfect his barn with a 1 to 1000 solution of bichloride of mercury. Mr. Anderson, Jr., was having his barn thoroughly disinfected, after destroying his animals. This division of the Experiment Station has heard no more from this outbreak, which is sufficient evidence that the work of eradication was thoroughly done.

While at Foreman the Inspector was called to see a horse at J. R. Olive's livery barn. Mr. Olive was very much surprised when he was told that his horse was suffering from farcy-glanders. He claimed that he had a veterinarian to prescribe for a horse that he (Mr. Olive) thought was affected in the same way as the one condemned by the Inspector. Fowler's solution of Arsenic was prescribed; this prescription is evidence that the veterinarian had farcy-glanders in mind when he prescribed it. After much urging on the part of the Inspector and the citizens of the town, Mr. Olive decided to have the three horses that he claimed were the only ones exposed tested. The three horses that were tested were not able to work and were placed out in an open shed to rest, along with the one condemned. But since he had only one common watering place, it was considered by the Inspector that all the stock in the barn was exposed equally in that way. When Mr. Olive was informed of this he wanted two very valuable dray mules tested. He had only had these mules in the barn for about two or three weeks. The Inspector insisted on being allowed to test an old heavy horse, and this was agreed to by Mr. Olive. There was nothing to indicate glanders in this horse save a slight watery discharge from the nostrils, and the coat was not healthy and the animal manifested an unhealthy condition. This made four horses and two mules that were tested. There was a positive reaction obtained from the four horses. No reaction from the two mules. Only one out of the four hoses tested, except the heavy horse, had any symptoms other than the discharge from the nostrils. One sorrel mare had farcy buds on inside of thigh, also enlarged glands along the groins. Permission was obtained from Mr. Olive to test with mallein all of the horses in the barn and the preliminary temperatures were taken of seven horses preparatory to inoculating at night, but the owner suddenly changed his mind and would not have them tested. So there was nothing for the Inspector to do more than to advise a thorough disinfection of the barn with a 1 to 1000 solution of bichloride of mercury, and then whitewash with a solution of the same proportion.

On the 24th of December, 1904, Mr. Perry Hester, living at Harris, Washington Co., Ark., ten miles from the Experiment Station, called at the Station for the purpose of getting information in regard to diseased stock. He stated that he had lost two mules, and gave the symptoms of farcy glanders. He had two mules at that time. One of them was a mass of sores near mouth, and legs were swollen and a few sores over them, as described by Mr. Hester. Arrangements were made to go out and see his mules, which was done on the 29th of December. There the Inspector found two mules affected very much like the description given by Mr. Hester. One of the mules was condemned. It showed a very typical case of farcy-glanders. The other was reserved for the mallein test, since it only showed enlarged submaxillary glands and a discharge from the nostrils. This mule reacted to the test, giving a good reaction. While at Mr. Hester's I was asked by Mr. Fletcher, a neighbor of Mr. Hester's to go and make an examination of his horse. This horse was an old family horse, age between fifteen and twenty years. The horse, as stated by his owner, had been shipped to and from Texas a time or two. I found this horse to be suffering from a chronic attack of glanders. Submaxillary glands were enlarged, discharge from both nostrils, ulcers in nostrils, coat rough, and presented a very unhealthy appearance. Mr. Fletcher did not seem to doubt my diagnosis, but insisted that I make a test on the horse, as he was desirous of seeing the effects. I tested the animal, found temperature normal before inoculation. After inoculation the temperature ran up to 104.5. He gave a distinct mallein reaction, as well as a good local reaction. All of these animals, both Hester's and Fletcher's, were turned into the same pasture during the fall of the year. They were killed and buried and a thorough disinfection of the barn was advised.

About the 1st of May, 1905, a telegram came from Paris, Logan Co., to examine diseased horses. Dr. Dinwiddie went on the following day and made an examination which resulted in condemning two horses in the Paris Livery, Feed & Sale Stable. Dr. Dinwiddie selected three horses to be tested, but on account of his presence being needed in the laboratory he returned and sent the regular Inspector to Paris to apply the test. It was decided by the Inspector and Mr. J. R. Smith (the manager of the barn) to test three others along with the three selected by Dr. Dinwiddie. There was a positive reaction obtained on two of the horses selected by Dr. Dinwiddie to be tested, and a doubtful reaction on the other; the other three giving no reaction at all. From the above results it was thought best to test all of the horses in the barn, which consisted of thirty head. There were five that gave a positive reaction, temperature running as high as 104.2 to 106 in all of them, with a good general and local reaction. The owners were advised to destroy those that gave a positive reaction, two of which showed symptoms of glanders. Those that gave a doubtful reaction, five in number and two that were not in a condition to be tested, it was advised that they be isolated on a good pasture and closely watched and tested later. The barn was disinfected according to the instructions of Dr. Dinwiddie as well as the harness that was used on the two horses condemned. While the Inspector was at Paris a horse was brought in from the country near for examination. It showed a plain case of glanders, and Mr. Johns who was in charge of the animal, was instructed to have it destroyed at once. This horse had at one time belonged to the owners of the Paris Livery barn and was traded off to its present owner. There was also another horse tested while at Paris. This horse showed that he was suffering from a nasal affection but it was thought best to test him since he had been kept in this livery barn some months previous to the present outbreak. There was no reaction from him, which proves that the diagnosis of nasal catarrh was probably correct. It could not be ascertained for certain where this outbreak of glanders came from but it was likely that it was brought into the barn by trading with transient horse traders.

About May 15, 1905, this Division of the Experiment Station was called on to inspect and investigate a disease among mules near Knoxville, Johnson Co., Ark. The mules were the property of Mr. J. A. Cain. Mr. Cain had lost two mules a short time before the outbreak was reported to the Experiment Station. Two mules of Mr. Cain showed well developed cases of glanders. They were ordered destroyed and a thorough disinfection of the barn and harness made. The two mules that died were traded for near Paris, Logan County, and it was supposed that they became infected from the outbreak there.

May 20, 1905, while the Inspector was at Smithdale, Cross Co. he was informed by Mr. W. L. Banks that Mr. R. G. Block, at Wynne, in the same county, had a horse that he wanted examined. Mr. Block was called up over the phone and it was agreed that the Inspector stop over at Wynne and examine this horse on his way back home. The Inspector arrived at Wynne about 2 o'clock on the morning of May 23d. The horse was examined and condemned as glandered. The left hind leg was swollen and corded and a number of farcy ulcers were present as well as enlarged submaxillary glands. Tubercles and small ulcers were present in the nostrils. The horse was also discharging from the nostrils. The owner of this horse insisted that he be tested as he seemed to be in doubt as to whether the horse was suffering from glanders or some other disease. Mr. Block had the horse examined in Memphis, Tenn., where he purchased him from a sale stable. The Veterinary, in Memphis, said there was nothing seriously wrong with the animal and prescribed for him. In order to satisfy the owner the horse was put through the mallein test. Mr. Block inquired at 10 o'clock on the night of the 23d, at which time the horse was inoculated, what he might expect next morning if the animal reacted to the test. He was told of the local reaction at the point of inoculation, which he would find on his arrival on the morning of the 24th. Mr. Block was up and at the barn by 5 o'clock on the following morning and the swelling at point of inoculation would have measured eight or nine inches across at 7 o'clock, when the Inspector arrived. So the owner was thoroughly convinced that the diagnosis was correct. There was a mare which had been purchased from the same sale stable in Memphis, from which the Block animal came, and was shipped to Wynne in the same car that the Inspector was called to examine. Mr. J. C. Mebans, the owner of this horse, stated that the mare had a discharge from the nostrils a few days before. There was found on examination by the Inspector an enlarged submaxillary gland, no discharge from nostrils, no farcy buds, and no ulceration of the nostrils. It was decided best to test this animal along with Mr. Block's, though she was found to have a temperature of 103.5. It was decided to go ahead with the test and depend altogether on the local mallein reaction. She gave neither a local or mallein reaction, so the owner was advised to watch her and isolate her from other horse stock and have her tested again in thirty or forty days.

Information of outbreaks of glanders for which no requests for examination were made by the owners, has also been received from various outside sources, including practicing veterinarians at Fort Smith, Lonoke and Camden.

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ARKANSAS EXPERIMENT STATION,

FAYETTEVILLE, ARK., September 1, 1906.

To His Excellency, JEFFERSON DAVIS,
Governor of Arkansas:

SIR—

I have the honor to transmit to you herewith the Nineteenth Annual Report of the Arkansas Agricultural Experiment Station.

Most respectfully,

W. G. VINCENHELLER,
Director.

Agricultural Experiment Station.

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EDITH BLACK	Executive Clerk

Correspondents should notify the Director of any change of Post Office Address, error in Address, or failure or delay in receiving Bulletins.

W. G. VINCENHELLER, Director,
Fayetteville, Ark.

REPORT OF DIRECTOR.

The published experiments of the Station for the year 1906 appear in full in succeeding pages of this report. The year's experimental work was published in four bulletins, which were mailed to all addresses on the Station's mailing list. A total of 45,000 copies was mailed out. The subjects of the bulletins are as follows:

Bulletin 88—Food Adulteration in Arkansas. By J. H. Norton.

Bulletin 89—Rice Growing in Arkansas. By W. G. Vincenheller.

Bulletin 90—The Cattle Tick in Washington and Benton Counties. By W. G. Vincenheller.

Bulletin 91—Suggestions upon the Care of Apple Orchards. By E. Walker.

The financial statement of receipts and expenditures for the year appears below.

W. G. VINCENHELLER,
Director.

FINANCIAL REPORT

Agricultural Experiment Station.

In Account with the United States Appropriation,

1906. DEBIT.

To receipts from the Treasurer of the United States as per appropriation for the year ending June 30, 1906	$15,000.00
	$15,000.00

CREDIT.

By Salaries	$ 7,724.92
Labor	2,152.24
Publications	1,119.35
Postage and Stationery	244.85
Freight and Express	435.87
Heat, Light and Water	161.75
Chemical Supplies	451.63
Seeds, Plants and Sundry Supplies	656.16
Fertilizers	45.75
Feeding Stuffs	132.45
Library	87.60
Tools, Implements and Machinery	172.50
Furniture and Fixtures	99.98
Scientific Apparatus	215.00
Live Stock	366.24
Traveling Expenses	566.54
Contingent Expenses	186.00
Building and Repairs	181.17
	$15,000.00

The foregoing statement is copied from the Experiment Station books, which have been examined and approved by the Auditing Committee of the Board of Trustees.

W. G. VINCENHELLER,
Director.

FOOD ADULTERATIONS.

By J. H. Norton, *Chemist.*

There is probably no subject of such universal importance or a subject so much discussed as is that of food adulteration. This subject is by no means a new one, for as far back as history dates there have been deceptions practiced in foods. It is true that within recent years this deception has been more skillfully practiced and the practice seems to be rapidly growing. This growth is due to the advancement in science and especially to the advancement in the knowledge of chemistry which adds each year to the already vast amount of knowledge of how to practice deception in foods. While the investigating theoretical chemist is discovering new facts about chemistry the impure food chemist is making use of these facts to further his own interests. There is then two kinds of knowledge, good and bad, which develop at the same time and are both of very great importance. No one has yet been able to distinguish between the sugar obtained from the sap of the maple tree and that obtained from the sap of the cane, hence, the adulteration of maple syrup and maple sugar with cane sugar.

The practice of using adulterants which are injurious to the healthy individual is rather limited, at the same time, it is an open question with many of the adulterants used, whether or not they are injurious. The sole object in food adulteration is for financial gain whether it be directly or indirectly. For example we might take the practice of watering milk, which is the addition of a harmless substance having a tendency to deceive the purchaser and have him believe he is getting more food than he really is. And on the other hand, take the practice of the addition of borax to various foods to prevent decomposition. This is a substance positively injurious to health as proven by the Bureau of Chemistry, U. S. Department of Agriculture. Then there are two reasons why food adulteration is of importance to the consumer, from the standpoint of nutrition and finance, and from the standpoint of health. A number of laws have been enacted and a number of investigations made concerning food and food adulteration by the Government and various states, a review of which might not be out of place here.

The federal laws enacted prior to July 1, 1902, have been for the purpose of revenue only and date back to July 4, 1861. The revenues obtained from these laws were largely from alcoholic beverages and artificial dairy products.

Three sources of food investigation has been going on to a greater or less extent for the past few years. These have been carried on under the direction of the Bureau of Chemistry, U. S. Department of Agriculture, under the directions of the Office of Experiment Stations, U. S. Department of Agriculture, and the Association of Official Agricultural Chemists besides the work done on foods by various individuals and especially by the Experiment Stations of the various states, and by Boards of Health.

The work done by the Association of Official Agricultural Chemists has only been in fair progress for the past three years and they have confined themselves to the methods of analysis of adulterated foods and to the establishment of standards for the purity of food products. The committee of food standards of the Association of Official Agricultural Chemists has been commissioned by the Secretary of Agriculture, under authority of the act of Congress approved March 3, 1903, to establish standards of purity of food products and to determine what are regarded as adulterations therein for the guidance of the officials of the various states and courts of justice. Their report so far has been published as circular No. 13, U. S. Dept. of Agr., Office of Secretary.

The work done under the direction of the Office of Experiment Stations, U. S. Dept. of Agr. has been along the line of dietetics and numerous bulletins have been published along this line, which include investigations that have been carried on with various classes of people, and under a wide variety of conditions. It seems that this office was the first in this country to systematically study these questions.

The Bureau of Chemistry, U. S. Dept. of Agr. has done more on the study of food adulteration than has any other organization in this country. They have directed the collection of data; they have made extensive investigations in the laboratory on food adulterations and methods of analysis, the results of which have been published as various parts of Bulletin No. 13. They have investigated the adulteration of drugs and chemicals the results of which have been published as Bulletin No. 80. For the past three years they have been investigating the effects of food preservatives on the human system and part of the results have been published as circular No. 15.

The various states have been passing pure food laws until most of them now have well regulated laws on this subject. Up to the present time this state has had no pure food law worthy of the name. It would seem from the rate that other states are passing and enforcing pure food laws that this state would be forced to pass one in self-defence. Since the Government has a committee of five of the best authorities on food standards in this country, it would seem wise for this state to adopt their standards wholly or in part and provide for the enforcement of such laws in this state. There is no reason why citizens of this state should tolerate adulterations of a nature injurious to health. It is true that the ones who are practicing such adulterations claim that the quantities used are too small to be injurious. We know that the system under perfectly healthy conditions may resist the attack of many diseases, but whether such resistance has weakened the system is too delicate a question to prove with our present knowledge of science. It is a poor excuse to offer then that we can not prove their injurious effects. The responsibility should be with the producer and he should be expected to prove their harmlessness. Those who use preservatives might say that we have no way of effecting preservation other than with chemicals. This statement is absurb and their only excuse for chemicals is that it is the cheapest method of sterilization. One may practice adulterating with harmless adulterations and still have the health of his fellow man at heart.

Seventy per cent of the population of this state are farmers which would class this state as an agricultural state with only a very small per cent engaged in manufacture. The surplus products are in the form of cotton and fruit which are sold on their merits alone without any deception. It has been stated that about one-fourth of the strawberries are lost in this state on account of the decrease in price each year. Is it not reasonable that if it were not for the adulterated fruit products on our markets this surplus of berries would be worked up as jelly, jam, preserves or canned? But as it is there is no hope for this to be done so long as articles are on the market bearing the label "Home Made Strawberry Jam," when in reality it is composed of apples, starch and glucose preserved with sulphites and colored with coal-tar dye. It is not an uncommon occurrence for a whole family to be made sick from some article of diet purchased on the open market and occasionally deaths result from the consumption of such articles.

The twelfth census report shows the death rate to be, in the registration area, which is composed of the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Michigan and the District of Columbia, from diarrheal diseases in cities to be greatest in July (49.8) and lowest in winter months, while in the rural districts it was highest in August (27.7) and lowest in winter months. The death rate from the registration area from these diseases has decreased from 183.7 per 100,000 of population in 1890, to 132.8 in 1900.

Death rate per 1000 of population.	1890.	1900.
Connecticut	18.6	17.0
District of Columbia	23.7	22.8
Massachusetts	19.3	17.7
New Hampshire	18.2	18.0
New Jersey	19.7	17.4
New York	19.6	17.9
Rhode Island	20.9	19.1
Vermont	15.8	17.0

"The effect of the advances made in medical science and sanitation, and in the preventive and restrictive measures enforced by local health authorities, which is indicated by the preceding table," etc. "The death rate per 100,000 of population in registration states from certain diseases come in the following order: Pneumonia (193.3), consumption (175.9), diarrhoeal diseases (132.2), cancer and tumor (67.7), diphtheria and croup (40.3), and influenza (29.1)." The foregoing statistics show that more than 7 per cent of the deaths are caused by diarrhoeal diseases which is undoubtedly largely due to dietary conditions, and the statistics further show that these conditions can be improved and have been improved in the registration area from 1890 to 1900.

There are but little more than half the fatalities in rural districts from diarrhoeal diseases as in the cities. We know that the food of the rural citizen is less subject to adulteration than is that for city consumption.

To show the exact condition of the food on the open market in this state, the Experiment Station has undertaken the investigation by purchasing samples on the open market as a private citizen without the merchant knowing the object of the purchase and analyzing them in the chemical laboratory.

The standards for the purity of foods observed were largely those given by the committee on food standards appointed by the Secretary of Agriculture while the analytical methods followed were almost entirely those found in "Food Inspection and Analysis" by Leach, analyst of the Massachusetts State Board of Health, from which the following definition is taken: "Except in special cases a food in general is deemed to be adulterated if anything has been mixed with it to reduce or lower its quality or strength; or if anything inferior or cheaper has been substituted wholly or in part therefor; or if any valuable constituent has been abstracted wholly or in part from it; or it contains wholly or in part of a diseased, decomposed, or putrid animal or vegetable substance; if any coloring, or coating, or otherwise it is made to appear of greater value than it really is; or if it contains any added poisonous ingredients."

Acknowledgment is due to Mr. C. W. Jones, who furnished much of the analytical data for this bulletin, and to Dr. Dinwiddie for writing the article on the physiological action of preservative drugs found in foods.

THE PHYSIOLOGICAL ACTION OF PRESERVATIVE DRUGS FOUND IN FOOD.

By R. R. DINWIDDIE, *M. D.*

Most of the substances used as food for man, except such as are in the dry state, are perishable under ordinary conditions. Various forms of decomposition, decay, fermentation or putrefaction occur, all being occasioned by the growth of microscopic organisms. Such foods can be preserved in the moist condition in two ways: (1) By cooking thoroughly, thus destroying all germ life, and then sealing up or canning in such a way as to prevent the access of germs later; (2) by adding to the foods substances which have the property of destroying these germs or preventing their growth. Frequently a combination of both of these methods is employed.

Preserving, by the aid of heat alone, or heat and sugar, as in canning fruits, is the old legitimate method employed by the housewife. This method is sometimes attended with practical difficulties, and in all cases is much less easy and profitable for commercial purposes than when chemical preservatives are employed. So the canning factory and the packing-house product have largely supplanted the home-made article.

Fruit preserved with salicylic acid, or meat with borax, or sulphites, will present a good appearance to the eye and there is less of loss from spoiled cans. If sufficiently "doped" it will keep even if the canning process be defective. It is natural therefore that the canning and packing companies, being in the business for the money there is in it, will adopt the most economical methods so long as they can do so without restriction.

The quantities of preservative drugs added is always much less than the amount necessary to cause acute poisoning. They are tasteless, or the taste is disguised by the spices, seasoning, or natural taste of the food itself. This art of adulteration and canning by the use of preservatives has so enormously increased in recent years that it has become necessary to say whether or not it is to be recognized as a legitimate practice.

The use of breakfast cereals and so-called "health foods" which has now become so general, is on a different footing since these being in the dry state require no preservatives.

Preservative Drugs.—All of these have the property of destroying or inhibiting germ life, that is, they are germicides or antiseptics according to the degree of their dilution, although they do not all produce their effects in the same way.

The bacteria which are the agents of decay consist of minute plant cells not greatly dissimilar in their constitution from the cells which line the walls of the stomach and intestine. When taken into the stomach germicides will act in the same way on the gastric cells as on the bodies of bacteria, destroying them if in sufficient strength or interfering with their function if in greater dilution. Their action is not confined to the digestive tract since when absorbed they are distributed throughout the body and finally excreted by the kidneys.

Experimenting either on man or animals to show the effects of such drugs may be useful in arousing the interest of the public, but no hygienist or physician requires any such demonstration to know that they may be harmful to health when used daily even in great dilution.

Although the general population may have little interest in drugs especially when in health, it is desirable that there should be a wider knowledge of those drugs with which we are daily doped in carelessly consuming the "embalmed" meats and doctored fruits of the packing house and factory.

Formaldehyde.—Sold as a solution in water, under the name of Formalin, Formalose and Formol; also forms the chief ingredient in a number of preservatives sold under proprietary titles.

It is a powerful germicide and inhibits germ multiplication even in high dilution. A favorite preservative for milks. It coagulates the protoplasm of the cell bodies and interferes with the action of the digestive ferments of the stomach. It is highly irritant to the skin and mucous membranes.

Sulphites.—The sulphites, as such, are not germicides and do not prevent putrefaction or decay. They are used to give a fresh appearance to stale meats thus masking their true condition. In the digestive tract the sulphites are decomposed and the sulphurous acid liberated. This also is highly irritant as well as germicidal.

Salicylic Acid, Salicin and the Salicylates.—These are frequently used in medical practice. They are highly antiseptic especially the two former, in dilution of 1 per cent or more, and in their excretion by the kidneys may act as irritants and will do so if in over doses. They also arrest the action of the digestive enzymes (pepsin, ptyalin, etc.) and hence their action must be highly prejudicial to the functions of the stomach.

Benzoic Acid.—Used to some extent in therapeutics. It acidifies the urine, and if long continued will act as an irritant to the kidneys. It also is decidedly antiseptic. Being highly acrid it will seldom be employed as a preservative except in highly spiced condiments, etc.

Boric Acid and Borax.—Boric acid arrests bacterial growth in dilution of 1 to 130 or less while borax has feeble antiseptic properties. Borax has a solvent action on the cuticle and is sometimes used as a cosmetic. Internally these preparations are not much used in medicine.

Copper.—The copper salts are highly irritant poisons to the lining membrane of the stomach and intestines, and should not be tolerated in food even in the highest degree of dilution. In minute doses they occasion bronchial and gastro-intestinal catarrh, colic, diarrhoea, and other troubles similar to those occasioned by lead poisoning.

Alum.—This acts as an astringent. It coagulates and arrests the action of the digestive ferments. In larger doses it is emetic and hence is highly irritant to the stomach walls. When in small doses long continued, as in bread made from alum baking powders, it will induce constipation and dyspepsia.

Saccharin.—A coal tar derivative recently discovered. It is 220 times sweeter than sugar but is not a food like sugar. Being antiseptic or germicidal, as well as intensely sweet, it can be conveniently used in fruit preserving, but until its action has been better studied its use for this purpose is inadmissable.

Coal Tar Dyes.—The effects of these in minute but long continued doses have not been fully investigated. Some appear to be but slightly poisonous and are extensively used in butter making and for coloring other articles of food.

The use even of these should not be encouraged until the effects have been more fully studied.

CANNED PEAS.

Canned peas are subject to adulterations with formaldehyde, salicylic acid, copper, saccharin and borax. They are also subject to being soaked, i. e., over-ripe peas soaked to imitate the green peas which can be detected by the enlarged germ, the deficiency of juice and being more mealy.

The following is a list of samples of peas analyzed. All samples were given a laboratory number for conveniencies for laboratory work

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
1	The Sears & Nichols Co., Chillicothe, O.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Sugar Loaf.
2	Myers & Hawkins, Baltimore.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Belle Isle.
3	B. Fouga, Bordeaux, France.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Petits Pois.
4	Magic Packing Co., Munice, Ind.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Sweet Clover.
11	Aughinbaugh Canning Co., Baltimore	Ashby Grocery Co., Fayetteville.	Sept. 19, 1904.	Early June.
12	Ridenour-Baker Grocer Co., Kan. City.	Ashby Grocer Co., Fayetteville.	Sept. 19, 1904.	F. F. O. G.
13	Geo. Dalidet & Co., Bordeaux, France.	Ashby Grocery Co., Fayetteville.	Sept. 19, 1904.	Petits Pois.
14	Whittier Cannery, Whittier, Cal.	Thomas Grocer Co., Fayetteville.	Sept. 19, 1904.	Quaker Colony.
15	For Fayetteville Grocer Co.	Gilbreath & Taylor, Fayetteville.	Sept, 19, 1904.	Choice Early June.
16	Aughinbaugh Canning Co., Baltimore	Gilbreath & Taylor, Fayetteville.	Sept. 19, 1904.	Golden Crown.
17	Goddard Grocer Co., St. Louis,	Gilbreath & Taylor, Fayetteville.	Sept. 19, 1904.	Sweet Home.
18	Goddard Grocer Co., St. Louis.	Gilbreath & Taylor, Fayetteville.	Sept. 19, 1904.	Dessert.
19	Beaumarchant.	Gilbreath & Taylor, Fayetteville.	Sept. 19, 1904.	Petits Pois.
157	Cabriel Trait & Co., Bordeaux, France.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Petits Pois.
158	Model Preserving Co. Model City, New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Reception.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
159	Van Camp Packing Co., Indianapolis, Ind.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Van Camp's
160	Erie Preserving Co., Buffalo, N. Y.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	French Sweet.
161	Model Preserving Co. Model City, N. Y.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Reception.
162	Sprague, Warner & Co., Chicago.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Genessee County.
163	L. A. Price, Bordeaux, France.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Extra Fins.
164	A. Perry Fils & Co., France.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Petits Pois.
165	Paul Taylor Brown Co., Baltimore.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Petits Pois Peas.
166	Plunkett Jarrell Grocery Co., Little Rock.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Blue Mountain.
167	Pewaukee Lake Canning Co., Prairieville, Wis.	C. J. Kramer & Co., Little Rock.	Nov. 15., 1904.	Pewaukee Lake.
168	Austin, Nichols & Co., New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Sunbeam.

All peas were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid, benzoic acid and copper. None contained formaldehyde, sulphites, saccharin, borax, salicylic acid or benzoic acid. Numbers, 3, 13, 19, 157, 163 and 164 each contained copper. Numbers, 2, 11 and 15 were poor grade of goods and unfit for use.

CANNED CORN.

Canned corn is apt to be adulterated with sulphites, saccharin, borax, formaldehyde or salicylic acid. Sulphites, or sulphurous acid is used as a bleaching agent.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
5	Iowa Canning Co., Vinton, Iowa.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Vinton Sugar.
31	Gibson Canning Co., Gibson, Ill.	Thomas Grocer Co., Fayetteville.	Oct. 4, 1904.	McCall's Best.
32	R. L. Craig & Co., Los Angeles.	Thomas Grocer Co., Fayetteville.	Oct. 4, 1904.	Monogram.
33	Kelly Canning Co., Waverly, Iowa.	Gilbreath & Taylor, Fayetteville.	Oct. 4, 1904.	Kelly's Extra Fancy
94	Martinsville Canning Co., Martinsv'le, Ind.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Standard.
95	Van Camp's Packing Co., Indianapolis, Ind.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Van Camp's
149	Balavia Preserving Co.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Genesee County.
150	For Plunkett-Jerrell Grocer Co., Little Rock.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Blue Mountain.
151	Francis H. Liggett & Co., New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Premier.
152	Austin Nichols & Co., New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Sun Beam.
153	Illinois Canning Co., Hoopeston, Ill.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Baby Bunting.

All samples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid with negative results in every sample.

CANNED BEANS.

Beans are apt to be adulterated with formaldehyde, salicylic acid, benzoic acid or sulphites. The use of which is for the purpose of preservation.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
6	Van Camp Packing Co., Indianapolis, Ind.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Van Camp's
7	Van Camp Packing Co., Indianapolis, Ind.	C. C. Conner & Co. Fayetteville.	Sept. 12, 1904.	Pork and Beans.
20	Blossom Canning Co., Rome, N. Y.	Gilbreath & Taylor, Fayetteville.	Sept. 23, 1904.	Refugee.
21	Ridenour-Baker, Kansas City, Mo.	Gilbreath & Taylor, Fayetteville.	Sept. 23, 1904.	Punch.
22	Aughinbough Canning Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Sept. 23, 1904.	Nigger Head.
23	Orchard Park Canning Co., Orchard Park, New York.	Ashby Grocer Co., Fayetteville.	Sept. 23, 1904.	Dinner Party.
24	Goddard Grocer Co., St. Louis.	Ashby Grocer Co., Fayetteville.	Sept. 23, 1904.	Dessert.
25	H. J. Heinz & Co., Pittsburgh, Pa.	C. C Conner & Co., Fayetteville.	Sept. 23, 1904.	Heinz's.
26	Gibbs Preserving Co., Baltimore.	Thomas Crocer Co., Fayetteville.	Sept. 23, 1904.	Extra Standard.
27	C. H. Pearson, Baltimore.	Lantrip & Miller, Fayetteville.	Sept. 23, 1904.	Peerless.
28	Van Camp Packing Co., Indianapolis, Ind.	Bates Bros., Fayetteville.	Oct. 3, 1904.	Red Kidney.
29	Aughinbaugh Canning Co., Baltimore.	Bates Bros., Fayetteville.	Oct. 3, 1904.	Nigger Head.
30	Clay City Packing Co., Clay City, Ind.	Lewis & Sharp Fayetteville.	Oct. 3, 1904.	Excelsior.
147	Austin, Nichols & Co. New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Bijou Lima.
148	Illinois Canning Co., Hoopeston, Ill.	C. J. Kramer & Co. Little Rock.	Nov. 15, 1904.	Joan of Arc.

All samples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid, and benzoic acid with negative results in each case.

MINCE MEATS.

The adulterations common to mince meats are borax, benzoic acid and salicylic acid, all of which are used as preservatives.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
8	Dodson-Braun Mfg. Co., St. Louis.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Extra Seedless.
126	Armour Packing Co., Kansas, City.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Helmet.
127	Cudahy Packing Co., U. S. A.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Diamond C.
128	Libby, McNeil & Libby, Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Libby's.
232	Armour & Co., Chicago.	J. S. Lackey, Fayetteville.	Dec. 15, 1904.	Star.
233	Fayetteville Grocery Co.	S. H. Jarman, Fayetteville.	Dec. 15, 1904.	Old Home.
234	Dodson-Braun Mfg. Co., St. Louis.	Thomas Grocer Co., Fayetteville.	Dec. 15, 1904.	From bulk.

All samples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. No results were abtained except in Numbers 8 and 234, and both these contained benzoic acid.

CANNED TOMATOES.

Tomatoes have been found to be adulterated with formaldehyde, salicylic acid, coal tar dyes and borax. The use of coal tar dye is for the purpose of improving the appearance without improving their value in the least.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
9	Springdale Canning Co., Springdale, Ark.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Springdale.
10	Van Camp Packing Co., Indianapolis, Ind.	C. C. Conner & Co., Fayetteville.	Sept. 12, 1904.	Van Camp.
34	Pierce City Canning Co., Pierce City, Mo.	Gilbreath & Taylor, Fayetteville.	Oct. 5, 1904.	Cupid.
35	Diggins Canning Co., Linington, Mo.	S. H. Jarman, Fayetteville.	Oct. 5, 1904.	Crown.
36	Aughinbaugh Canning Co., Baltimore.	J. S. Lackey, Fayetteville.	Oct. 5, 1904.	Golden Crown.
37	Marshfield Canning Co., Marshfield, Mo.	C. C. Conner & Co., Fayetteville.	Oct. 5, 1904.	Mountain Queen.
38	Houghland Bros., Underwood, Ind.	Frank E. Gay, Fayetteville.	Oct. 5, 1904.	Hoosier Belle.
96	Arkansaw Canning Co., Prairie Grove, Ark.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Then and Now.
154	Model City Preserving Co., Model City, N. Y.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Reception.
155	Plunkett & Jarrett Little Rock.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Blue Mountain.
156	Ontario Preserving Co., Ontario, Can.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Ferndell.

All samples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid, benzoic acid and coal tar dyes with negative results. Numbers 36 and 38 were in a poor state of preservation.

CANNED PEARS.

It seems that pears are very little the subject of adulteration.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
39	Aughinbaugh Canning Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Oct. 7, 1904.	Golden Crown.
40	Salem Canning Co., Salem, Ore.	Gilbreath & Taylor, Fayetteville.	Oct. 7, 1904.	Thistle.
41	Whittier Canning Whittier, Cal.	Thomas Grocer Co., Fayetteville.	Oct. 7, 1904.	Quaker Colony.
42	Ridenour-Baker Grocery Co., Kansas City, Mo.	C. C. Conner & Co., Fayetteville.	Oct. 7, 1904.	Morning Glory.
43	California Canneries Co., San Francisco, Cal.	Asbhy Grocer Co., Fayetteville.	Oct. 7, 1904.	Bear.
44	Nile Packing Co., Fresno, Cal.	Lewis & Sharp Fayetteville.	Oct. 7, 1904.	Nile.
174	A. F. Tenney Canning Co., Fresno, Cal.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Diamond D

Of the seven samples analyzed only two were defective. All were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. The can of Number 39 was badly corroded and the contents of the can contained .08% tin (mettastannic acid). Only three cans of the brand of Number 40 were found on the market and the other were bulged at the ends, which indicates that decomposition had taken place while the one analyzed contained formaldehyde.

CANNED PEACHES.

Canned peaches are but little the subject of adulteration.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
45	Goddard Grocer Co., St. Louis.	S. H. Jarman, Fayetteville.	Oct. 8, 1904.	Dessert, Yellow Crawford.
46	A. F. Tenney Canning Co., Fresno, Cal.	S. H. Jarman, Fayetteville.	Oct. 8, 1904.	Dessert, Lemon Cling.
47	A. F. Tenney Canning Co., Fresno, Cal.	S. H. Jarman, Fayetteville.	Oct. 8, 1904.	Dessert, White Heath.
48	Nile Packing Co., Fresno, Cal.	Gilbreath & Taylor, Fayetteville.	Oct. 8, 1904.	Gladiator, White. Heath.
49	Home Preserving Co., San Jose, Cal.	Gilbreath & Taylor, Fayetteville.	Oct. 8, 1904.	Yellow Free
50	Aughinbaugh Canning Co., Balitmore.	Gilbreath & Taylor, Fayetteville.	Oct. 8, 1904.	Yellow, 1st Quality of this Brand
51	Springdale Canning Co., Springdale, Ark.	Gilbreath & Taylor, Fayetteville.	Oct. 8, 1904.	Pie Peaches.
52	Ferndale Canning Co., Brooklyn, Cal.	J. S. Lackey, Fayetteville.	Oct. 8, 1904.	Fern Yellow Free.
53	Edward J. Wallace & Co., Baltimore.	C. C. Conner & Co., Fayetteville.	Oct. 8, 1904.	Fresh, 1st Quality.
54	Redwood Canning Co., Redwood, Cal.	C. C. Conner & Co., Fayetteville.	Oct. 8, 1904.	Duchess, Crawford.
55	Ridenour-Baker Grocer Co., Kansas City, Mo.	Ashby Grocer Co., Fayetteville.	Oct. 8, 1904.	Punch, Yellow Free.
56	Ridenour-Baker Grocer Co., Kansas City, Mo.	Ashby Grocer Co., Fayetteville.	Oct. 8, 1904.	F. F. O. G. Yellow Crawford.
57	Sonoma Packing Co., Sonoma, Cal.	Bates Bros., Fayetteville.	Oct. 10, 1904.	California, Yellow Crawford.
169	California Canneries Co., San Francisco.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Bear.
170	Ontario Preserving Co., California.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Ferndell.
171	Austin, Nichols & Co., New York.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Sunbeam.
172	A. F. Tenney, Canning Co., Fresno, Cal.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Diamond D
173	Dunkley Co., Kalamazoo, Mich.	C. J. Kramer & Co., Little Rock.	Nov. 15, 1904.	Golden Luncheon.

All sample were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. Numbers 50 and 53 were undoubtedly adulterated with water while Number 47 contained borax.

CANNED APRICOTS.

These goods are very little subject to adulteration as shown by the following table:

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
58	A. F. Tenney Canning Co., Fresno, Cal.	S. H. Jarman, Fayetteville.	Oct. 12, 1904.	Dessert Extra Standard.
59	Nile Packing Co., Fresno, Cal.	S. H. Jarman, Fayetteville.	Oct. 12, 1904.	Gladiator.
60	Fresno Fruit Canning Co., Fresno, Cal.	Gilbreath & Taylor, Fayetteville.	Oct. 12, 1904.	Tiger.
61	Whittier Cannery Whittier, Cal.	Thomas Grocer Co., Fayetteville.	Oct. 12, 1904.	Quaker Colony.
62	G. H. Waters & Co., Ponmoa, Cal.	C. C. Conner & Co., Fayetteville.	Oct. 12, 1904.	Surf Standard.
63	Santa Clara Packing Co., San Francisco.	Bates Bros., Fayetteville.	Oct. 12, 1904.	San Clara Red Star.

All samples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. All samples were pure.

CANNED STRAWBERRIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
64	C. H. Pearson Packing Co., Baltimore.	S. H. Jarman, Fayetteville.	Oct. 13, 1904.	Peerless.
65	Aughinbaugh Canning Co., Baltimore.	Lantrip & Miller, Fayetteville.	Oct. 13, 1904.	Nigger Head.

The strawberries were tested for formaldehyde, sulphites, saccharine, borax, salicylic acid and benzoic acid. No preseravtive was found. Number 64 contained some sand.

CANNED BLACKBERRIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
66	C. H. Pearson Packing Co., Baltimore.	S. H. Jarman, Fayetteville.	Oct. 13, 1904.	Peerless.
67	Aughinbough Canning Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Oct. 13, 1904.	Nigger Head.

The blackberries were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. Both samples contained salicylic acid.

CANNED RASPBERRIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
68	Aughinbaugh Canning Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Nigger Head

The raspberries were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid and found to be pure.

CANNED APPLES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
69	Springdale Canning Co., Springdale, Ark.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Springdale.

The apples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid and found to be pure.

CANNED GRAPES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
70	A. F. Tenney Canning Co., Fresno, Cal.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Dessert.

The grapes were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid and found to be pure.

CANNED PLUMS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
71	A. F. Tenney Canning Co., Fresno, Cal.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Dessert.
72	Ridenour-Baker, Kansas City, Mo.	Bates Bros., Fayetteville.	Oct. 14, 1904.	Punch.

The plums were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid and found pure.

CANNED CHERRIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
73	Cotton Bell & Co., San Francisco.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Volcano.
74	C. H. Pearson Packing Co., Baltimore.	S. H. Jarman, Fayetteville.	Oct. 14, 1904.	Peerless.
75	Bendel-Nelson Co., Gridley, Cal.	Thomas Grocer Co., Fayetteville.	Oct. 14, 1904.	Premio.

The cherries were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid and none found. Number 74 contained some larvae.

CANNED GOOSEBERRIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
82	Aughinbaugh Canning Co., Baltimore.	Lewis & Sharp, Fayetteville.	Oct. 14, 1904.	Nigger Head.

The gooseberries were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. The sample was pure.

CANNED SQUASH.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
91	Van Camp Packing Co., Indianapolis, Ind.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Boston Marrow.

The squash was tested for formaldehyde, sulphites, saccharin, borax, salicylic acid, benzoic acid and tin. Tin was found.

CANNED HOMINY.

Canned hominy is very apt to be adulterated with sulphites which have been used as a bleaching agent.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
89	Aughinbaugh Canning Co., Baltimore.	C. C. Conner & Co., Fayetteville.	Oct. 15, 1904.	Nigger Head.
90	Van Camp Packing Co., Indianapolis, Ind.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Van Camp's

The hominy proved to be free from formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid.

CANNED MUSHROOMS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
92	Geo. Dalidet & Co., Bordeaux, France.	C. C. Conner & Co., Fayetteville.	Oct. 15, 1904.	D'Hotel.
93	Barton Fils, Paris, France.	S. H. Jarman, Fayetteville.	Oct. 15, 1904.	Extra.

The mushrooms were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. Number 92 contained sulphites.

CANNED ASPARAGUS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
86	Goddard Grocery Co., St. Louis.	C. C. Conner & Co., Fayetteville.	Oct. 15, 1904.	Dessert.
87	Oakland Preserving Co., Oakland, Cal.	C. C. Conner & Co., Fayetteville.	Oct. 15, 1904.	Del Monte.
88	Oak Canning Co., Oakland, Cal.	C. C. Conner & Co., Fayetteville.	Oct. 15, 1904.	Manzanita.

All asparagus was tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. All samples proved to be pure.

CANNED PUMPKINS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
83	Van Camp Packing Co., Indianapolis, Ind.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Pie.
84	Springdale Canning Co., Springdale, Ark.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Springdale.
85	Goddard Grocer Co., St. Louis, Mo.	Gilbreath & Taylor, Fayetteville.	Oct. 15, 1904.	Sweet Home.

The samples of pumpkins were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. All samples were pure.

CANNED PINEAPPLES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
76	Goddard Grocer Co., St. Louis, Mo.	Gilbreath & Taylor, Fayetteville.	Oct. 14, 1904.	Dessert, Fancy Grated.
77	Marti Wagner Co., Baltimore.	Bates Bros., Fayetteville.	Oct. 14, 1904.	Dessert, Extra Fancy.
78	Aughinbaugh Canning Co., Baltimore.	Bates Bros., Fayetteville.	Oct. 14, 1904.	Nigger Head.
79	Oriental American Co., Portland, Ore.	Thomas Grocer Co., Fayetteville.	Oct. 14, 1904.	Malay Sliced.
80	Moore & Brady, Baltimore.	C. C. Conner & Co., Fayetteville.	Oct. 14, 1904.	Acorn.
81	Evans, Day & Co., Baltimore.	C. C. Conner & Co., Fayetteville.	Oct. 14, 1904.	Eyeless and Coreless.

All pineapples were tested for formaldehyde, sulphites, saccharin, borax, salicylic acid and benzoic acid. The samples were pure.

MEAT AND MEAT PRODUCTS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
103	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Libby's Potted Tongue.
104	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Libby's Potted Chicken.
105	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Libby's Potted Turkey.
106	Van Camp Packing Co., Indanapolis, Ind.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Van Camp's Potted Tongue.
107	J. M. Anderson & Co., St. Louis, Mo.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Santa Claus Potted Sardines.
97	C. H. Hammond, Chicago.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Coin Special Potted Ham.
98	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Libby's Potted Ham.
99	Van Camp Packing Co., Indianapolis, Ind.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Can Vamp's Deviled Ham.
100	Underwood Co., Boston.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Original Deviled Ham.
101	Morris & Co., Chicago.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Lion Boiled Ham.
102	Libby, McNeil & Libby, Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Libby's HamLoaf.
129	Libby, McNeil & Libby, Chicago.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Libby's Veal Loaf.
130	Libby, McNeil & Libby, Chicago.	C C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Libby's Chicken Tamale.
131	Van Camp Packing Co., Indianapolis, Ind.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Van Camp's Concentrated Chicken Soup.
132	Libby, McNeil & Libby, Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Libby's Vienna Sausage.
133	Libby, McNeil & Libby, Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	The best Lunch Tongue.
134	Armour Pkg. Co., Kansas City.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Magnet, Chipped Dried Beef

MEAT AND MEAT PRODUCTS.—CONTINUED.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
135	Armour Pkg. Co., Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Extract of Beef.
136	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Peerless. Dried Beef
137	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4., 1904.	Peerless Corned Beef Hash
138	Fairbanks Canning Co., Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Lion, Dried Beef.
139	Nelson Morris & Co., Chicago.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Extra Choice Dried Beef
140	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Hamburger Steak.
141	Fairbanks Canning Co., Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Lion Corned Beef.
142	Armour Pkg. Co., Kansas City.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	White Label Smoked Beef.
143	Libby, McNeil & Libby, Chicago.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	The Best Brisket Beef.
144	Armour & Co., Chicago.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Sliced Star Bacon.
145	Nelson Morris & Co., Chicago.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Supreme Sliced Bacon.
146	Armour Pkg. Co., Kansas City, Mo.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Cold Sliced Bacon.
108		Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Tom Sardines.
109		Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	French Ball Royans Sardines.
110	North Lubec Canning Co., North Lubec, Me.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Dirigo Sardines.
111	North Lubec Canning Co., North Lubec, Me.	Bates Bros., Fayetteville.	Nov. 4., 1904.	Diamond Sardines.
112	L. O. Clark & Sons, East Port, Me.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Moose Head Sardines.

MEAT AND MEAT PRODUCTS—CONTINUED.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
113	Eclipse Pkg. Co., Astoria, Ore.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Cow Boy Salmon.
114	White Crest Canning Co., Anacortes, Wash.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	White Crest Salmon.
115	Pacific Co., Ilwaco, Wash.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Clover Leaf Salmon.
116	Fidalgo Island Canning Co.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Prelate Salmon.
117	E. C. Joullian Pkg. Co., Biloxi, Miss.	Bates Bros., Fayetteville.	Nov. 4, 1904.	Union Cove Oyster.
118	Aughinbaugh Canning Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	York River Nigger Head Oyster.
119	Baltimore Oyster Co., Baltimore.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Berwic Bay Oysters.
120	Turner Reed & Co., Christian, Miss.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	King Fisher Oysters.
121	John Dalton, Morgan City, La.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Berwic Bay Schrimp.
122	G.W.Dunbais & Sons, New Orleans.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Barataria Schrimp.
123	Wm. Underwood Co., Boston.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	Little Neck Clams.
124	San Pedro Canning Co., San Pedro, Cal.	Gilbreath & Taylor, Fayetteville.	Nov. 4, 1904.	San Nicholas Rock Lobster.
125	McMenamin & Co., Hampton, Va.	C. C. Conner & Co., Fayetteville.	Nov. 4, 1904.	Fresh Deviled Crabs.
210		D. M. Harbinson, Fayetteville.	Dec. 13, 1904.	Oysters from bulk.
344		Algie Moore, Fayetteville.	March 30, 1905.	Cod Fish Dried.

Of the forty-nine samples analyzed none contained formaldehyde, sulphites, saccharin, salicylic acid, benzoic acid or coal tar dye. One contained nitre, No. 101; four contained borax, Nos. 101, 124, 210 and 344 and eight contained starch, Nos. 97, 98, 129, 130, 131, 132, 137 and 140.

CATSUPS.

Catsups with few exceptions are always adulterated. They have been found adulterated with formaldehyde, sulphites, borax, salicylic acid, benzoic acid and artificial coloring matter, and yet, even though many of them state the adulteration on the bottle, the consumer still persists in eating such unwholesome articles of diet.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.	% OF ACID.
175	Standard Packing Co., St. Louis.	Geo. C. Koonce & Co., Little Rock.	Nov. 18, 1904.	Phoenix.	1.20
176	Libby, McNeil & Libby, Chicago.	Paul & Pat, Little Rock.	Nov. 18, 1904.	Libby's.	.91
177	The Williams Bros. Detroit.	S. W. Jacks, Little Rock.	Nov. 18, 1904.	Waldorf.	.92
178	Dodson-Braun, St. Louis.	McLees & Lucas, Little Rock.	Nov. 18, 1904.	Blue Point.	1.14
179	Dodson-Braun, St. Louis.	McLees & Lucas, Little Rock.	Nov. 18, 1904.	From bulk.	1.48
180	Dodson-Braun, St. Louis.	C. J. Kramer & Co., Little Rock.	Nov. 18, 1904.	Faust's Oyster Cocktail	1.24
181	T. A. Snyder Preserving Co., Cincinnati.	C. J. Kramer & Co., Little Rock.	Nov. 18, 1904.	Snyder's.	.50
182	H. J. Heinz & Co., Pittsburgh, Pa.	C. J. Kramer & Co., Little Rock.	Nov. 18, 1904.	Heinz.	.91
183	Ontario Preserving Co., Cincinnati.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Ferndell.	.81
184	Eddy & Eddy, St. Louis.	W. M. Branch, Little Rock.	Nov. 18, 1904.	Eddy's.	1.08
185	The Hyman Pickle Co., Louisyille, Ky.	W. M. Branch, Little Rock.	Nov. 18, 1904.	Hyman's.	1.81
186	Louisville Cider & Vinegar Works, Louisville, Ky.	W. M. Branch, Little Rock.	Nov. 18, 1904.	Pride of Kentuc'y	.94
187	The Hyman Pickle Co., Louisville, Ky.	W. M. Branch, Little Rock.	Nov. 18, 1904.	American	1.26
202	Unknown.	Unknown.			1.58

The per cent of acid present is acetic acid from the vinegar used and has no reference to the harmful acids used.

One sample, Number 182, was of high grade and unobjectionable while three

Numbers, 183, 185 and 186, stated their adulteration on the container, Numbers 183 and 185 contained benzoic acid, and Number 186 contained benzoic acid and coal tar dye. Leaving ten, Numbers 175, 176, 177, 178, 179, 180, 181, 184, 187 and 202, which contained benzoic acid with no information to that effect on the container and out of these ten, eight Numbers 175, 177, 178, 179, 180, 184, 187 and 202, contained coal tar dyes and one, Number 202, contained salicylic acid.

TABLE SAUCES.

These could well be classed with catsups as the method of preparation and adulteration is very much the same.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.	% OF ACID.
188	G. Trait & Co., Bordeaux, France.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Moutarde	5.01
189	Gebhardt Chili Powder Co., San Antonio, Tex.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Mexican Piquins	3.89
190	Gebhardt Chili Powder Co., San Antonio, Texas.	C. J. Kramer & Co. Little Rock.	Nov. 18. 1904.	Perkin Sauce.	5.98
191	D. C. Danove, New Orleans.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Maunsel White Extract of Pepper.	3.32
192	McMechens, Wheeling, W. Va.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Mustard.	1.84
193	Wright Smith Mfg. Co., St. Louis.	C. J. Kramer & Co. Little Rcok.	Nov. 18, 1904.	Thunder and Lightning	2.16
194	The Williams Bros. Co., Detroit, Mich.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	ChiliSauce Waldorf.	.66
195	Eddy & Eddy, St. Louis.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Salad Mustard.	4 23
196	Dodson-Braun, St. Louis.	C. J. Kramer & Co. Little Rock.	Nov. 18, 1904.	Mustard, Prepared aux fines herbes.	4.27

Of the nine samples analyzed, one Number 194 contained benzoic acid and three Numbers 190, 192 and 194 contained coal tar dye.

DRIED FRUIT.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	KIND.
203		Gilbreath & Taylor, Fayetteville.	Dec. 12, 1904.	Apples.
204		Gilbreath & Taylor, Fayetteville.	Dec. 12, 1904.	Peaches.
205		Gilbreath & Taylor, Fayetteville.	Dec. 12, 1904.	Prunes.
206		Gilbreath & Taylor, Fayetteville.	Dec. 12, 1904.	Apricots.
207		Gilbreath & Taylor, Fayetteville.	Dec. 12, 1904.	Grapes.
208		C. C. Conner & Co., Fayetteville.	Dec. 12, 1904.	Figs.
209		C. C. Conner & Co., Fayetteville.	Dec. 12, 1904.	Pears.

Five Numbers 203, 204, 206, 208 and 209 of the seven samples contained sulphurous acid and one Number 203 of these contained salicylic acid.

DAIRY PRODUCTS.

SAMPLE NO.	DEALER.	CONSUMER.	DATE.	KIND.	Samp'l % of fat.	% of solids not fat
211	Dowell, Fayetteville.	Bachelor's Hall, Fayetteville.	Dec. 14, 1904.	Milk.	5.1	9.4
212	Harding, Fayetteville.	U. of A. Dormitory, Fayetteville.	Dec. 14, 1904.	Milk.	4.1	7.4

Number 212 had been watered but contained no preservative.

BAKING POWDERS.

SAMPLE NO.	219	220	221	222
Packed by	Bain & Chapman St. Louis.	Jaques Mfg. Co. Chicago.	The Southern Mfg. Co., Richmond, Va.	Price Baking Powder Co., Chicago.
Retailed by	Bates Bros., Fayetteville.	Bates Bros., Fayetteville.	Bates Bros. Fayetteville.	Bates Bros., Fayetteville.
Date of Purchase	Dec. 14, 1904	Dec. 14, 1904	Dec. 14, 1904	Dec. 14, 1904
Brand	Jack Frost	K. C.	Good Luck	Dr. Price's
Price in cents	.25	.15	.10	.25
% of insoluble ash	2.99	.82	.82	.02
% of lime [CaO]	1.60	1.22	.10	0.00
% of alum (Al_2O_3)	3.22	4.13	6.62	0.00
% of phosphoric acid (P_2O_5)	6.92	0.00	0.00	0.00
% of soda [Na_2O]	10.47	9.03	14.02	7.30
% of potash (K_2O)	1.01	1.61	1.14	9.82
% of sulphates (SO_3)	11.62	13.38 43.97	20.06 25.31	.06 29.93
% of starch	30.17			
% of moisture	12.46	11.54	14.98	13.06
% of total carbon dioxide	19.54	14.29	16.95	14.15
% of tartaric acid	0.00	0.00	0.00	25.64
% of available carbon dioxide	17.79	13.39	16.95	13.92

SAMPLE NO.	223	224	225
Packed by	Leon Specialty Co., St. Louis.	Eddy & Eddy, St. Louis.	C. A. Murdock Mfg. Co., Kansas City, Mo.
Retailed by	Ashby Grocer Co., Fayetteville.	Ashby Grocer Co., Fayetteville.	Ashby Grocer Co., Fayetteville.
Date of Purchase	Dec. 15, 1904.	Dec. 15, 1904.	Dec. 15, 1904.
Brand	White Clover.	Eddy's Reliable.	Manhattan
Price in cents.	.50	.15	.15

BAKING POWDERS.—Continued.

SAMPLE NO.	223	224	225
% of insoluble ash	.36	13.65	.73
% of lime (CaO)	0.00	3.91	0.00
% of alum (Al_2O_3)	3.95	0.00	3.02
% of phoshporic acid (P_2O_5)	0.00	17.74	0.00
% of soda (Na_2O)	8.27	8.43	9.03
% of potash (K_2O)	.48	.49	3.79
% of sulphates (SO_3)	11.64	1.24	10.80
% of starch	51.09	24.08	49.56
% of moisture	13.49	14.16	10.26
% of total carbon dioxide	10.72	16.30	12.81
% of tartaric acid	0.00	0.00	0.00
% of available carbon dioxide	10.57	14.90	11.42

SAMPLE NO.	226	227	228
Packed by	Royal Baking Powder Co. New York.		Dodson & Hils, St. Louis.
Retailed by	C. C. Conner & Co., Faytteville.	C. C. Conner & Co., Fayetteville.	C. C. Conner & Co., Fayetteville.
Date of Purchase	Dec. 15, 1904.	Dec. 15, 1904.	Dec. 15, 1904.
Brand	Royal.	Banner	Dodson & Hils.
Price in cents	.10	.10	.15
% of insoluble ash	.02	8.53	2.24
% of lime (CaO)	0.00	5.06	.22
% of alum (Al_2O_3)	0.00	5.30	5.18
% of phosphoric acid (P_2O_5)	0.00	0.00	0.00
% ofsoda (Na_2O)	8.10	9.85	12.06
% of potash (K_2O)	11.16	1.52	1.81
% of sulphates (SO_3)	0.00	25.18	19.47
% of strach	25.90	18.07	31.69
% of moisture	11.05	12.80	13.45
% of total carbon dioxide	14.70	13.69	13.88
% of tartaric acid	29.07	0.00	0.00
% of available carbon dioxide	14.48	13.21	13.35

BAKING POWDERS.—CONTINUED.

SAMPLE NO.	229	230	231
Packed by	J. A. Folcher & Co., San Francisco.	Rumford Chemical Works, Providence, R. I.	J. C. Grant, Chemical Co.
Retailed by	Thomas Grocer Co., Fayetteville.	Thomas Grocer Co., Fayetteville.	J. S. Lackey, Fayetteville.
Date of Purchase	Dec. 15, 1904.	Dec. 15, 1904.	Dec. 15, 1904
Brand	Golden Gate.	Rumford.	Spot Cash.
Price in cents.	.20	.15	.10
% of insoluble ash..	0.00	6.64	.68
% of lime (CaO)....	.28	6.39	.33
% of alum (Al_2O_3)..	0.00	0.00	5.11
% of phosphoric acid (P_2O_5)...........	0.00	17.03	0.00
% of soda (Na_2O)..	9.79	7.79	9.52
% of potash (K_2O).	18.93	.48	1.52
% of sulphates (SO_3)	15.81	.14	14.52
% of starch........	0.00	34.70	46.78
% of moisture	8.24	13.11	11.65
% of total carbon dioxide	14.26	13.72	9.89
% of tartaric acid..	32.69	0.00	0.00
% of available carbon dioxide	14.06	12.33	9.82

No article of diet has been so much the subject of controversy and the subject of so much litigation as has baking powders. There is a popular opinion that baking powder should contain starch to take up the moisture and thereby prevent decomposition, but from actual experience it seems that this opinion is erroneous and that starch should be classed as an adulteration. This being true not one of the thirteen samples analyzed was free from adulteration. The question then in buying a powder is to secure the one which is least objectionable. Numbers 222 and 226 were adulterated only with starch. Numbers 229 contained a high per cent. of sulphates. Numbers 224, 219, 227, 228 and 230 contained a large residue from the ash which was insoluble in dilute hydrochloric acid. Numbers 220, 221, 223, 225, 227, 228 and 231 were all alum powders while Numbers 219, 224 and 230 were phosphate powders and Numbers 222, 226 and 229 were tartarte powders. The only adulteration in these powders which can not be claimed to be injurious is starch.

JELLIES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
270	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23. 1904.	Blackberry.
271	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Lemon Medallion.
272	Bishop & Co., Los Angeles, al.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Guava Medallion.
273	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Grape.
274	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Grape Medallion.
275	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23. 1904.	Plum.
276	Dodson-Braun St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Plum Cupid.
277	Dodson-Braun St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Raspberry Cupid.
278	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Raspberry.
279	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberry.
280	Dodson-Braun St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberry. Cupid.
281	Dodson-Braun St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Apple Cupid.
282	Standard Packing Co., St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Apple Holly.
283	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Apple.
284	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Currant.
285	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Currant Cupid.
286	Standard Packing Co., St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Currant Holly.
287	St. Louis Syrup & Preserving Co.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	(Bucket) Currant.

JELLIES.—CONTINUED.

Of the eighteen samples of jelly analyzed eight Numbers 270, 273, 275, 278, 279, 282, 286 and 287 contained sulphites, nine Numbers 270, 273, 275, 278, 279, 282, 283, 286 and 287 glucose, nine Numbers 270, 273, 275, 276, 278, 279, 280, 285 and 268 coal tar dye and eleven Numbers 270, 273, 275, 277, 278, 279, 280, 281 282, 283 and 286, starch. No arga agar or gelatine was found in any sample. Five samples Numbers 270, 273, 275, 278 and 279, contained the following lable "This package contains flavored jelly, fruit color compounded 30 per cent apple juice, 70 per cent corn syrup," and contained in addition to what the label stated; starch, sulphites and coal tar dyes. Of the five Numbers 276, 277, 280, 281 and 285 labeled "Guaranteed pure fresh fruit juice. White sugar," three Numbers 276, 280 and 285 contained coal tar dyes. None contained formaldehyde, saccharin, salicylic acid, benozic acid or borax.

PRESERVES.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
239	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Orangeate Medallion.
240	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Grape Fruitate Medallion
241	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23. 1904.	Cherries, Tiger.
242	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23. 1904.	Apricots, Columbia.
243	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Peaches. Columbia.
244	St. Louis Syrup & Presserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904	Pears Columbia.
245	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Pears, Tiger.
246	Dodson-Braun, St. Louis.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Blackberries Cupid.
247	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Blackberries Columbia.
248	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Plums Columbia.
249	Dodson-Braun, St. Louis.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Plums, Damson, Extra Quality.
250	Dodson-Braun, St. Louis.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Red Raspberries. Cupid.

PRESERVES.—CONTINUED.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
251	Flacus Bros., Wheeling, W. Va.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Red Raspberries, Steer's Head.
252	Flacus Bros., Wheeling, W. Va.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Black Rasp. berries, Steer's Head.
253	Flacus Bros., Wheeling, W. Va.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Strawberries, Steer's Head.
254	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberries, Tiger.
255	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberries, Columbia.

Of the seventeen samples analyzed, not one was free from deception None contained formaldehyde, saccharin, salicylic acid, benzoic acid, borax or starch. All except Numbers 251, 252 and 253 contained sulphites. Numbers 241, 242, 243, 247, 248, 250, 253, 254 and 255 contained coal tar dyes All contained glucose except Numbers 239 and 240.

JAMS.

SAMPLE NO.	PACKED BY	RETAILED BY	DATE OF PURCHASE.	BRAND.
256	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Currant, Medallion.
257	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Peach, Extra. Quality.
258	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Plum, Extra Quality.
259	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Plum, Home Made.
260	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Cherry, Extra Quality.
261	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Cherry, Home Made.
262	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Blackberry, Extra Quality.
263	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Blackberry. Medallion.
264	Bishop & Co., Los Angeles, Cal.	FOliver-innie Grocer Co., Hot Springs.	Dec. 23, 1904.	Raspberry Medallion.
265	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Raspberry, Extra Quality.
266	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Raspberry, Home Made.
267	St. Louis Syrup & Preserving Co.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberry, Home Made.
268	Dodson-Braun, St. Louis, Mo.	Sammons & Son, Hot Springs.	Dec. 23, 1904.	Strawberry, Extra Quality.
269	Bishop & Co., Los Angeles, Cal.	Oliver-Finnie Grocer Co., Hot Springs.	Dec. 23, 1904.	Strawberry, Medallion.

Of the fourteen samples of jams analyzed, none contained saccharin salicylic acid, benzoic acid or borax. Number 256 contained formaldehyde. All except Numbers 256, 263, 264 and 269, contained sulphites. Numbers 259 260, 261, 262, 265, 266, 267 and 268 contained starch. Numbers 256, 258, 259, 260, 261, 266, 267 and 268 contained coal tar dyes. All contained glucose except Numbers 256, 263, 264 and 269.

The most extreme case of food adulteration was found in Number 267. Which was labeled "Home Made Strawberry Jam" and in reality was composed of apples, starch and glucose, with three berries in a half pint, colored with coal tar dye and contained sulphites.

CANDY.

SAMPLE NO.	RETAILED BY	KIND.	STARCH	COAL TAR DYE	% OF ASH.	% OF CANE, SUGAR.	% OF GLUCOSE.
288	Mix & Taffy joint Ft. Smith.		none.	present	.17	67	26
289	Candy Wagon, Ft. Smith.		present	none.	.39	28	30
290	Candy Wagon, Ft. Smith.	Colored Sheets.	present	present	.56	10	45
291	Bogganio, Ft. Smith.	Cocoanut.	none.	none.	.61	00	55
292	Bogganio, Ft. Smith.		present	none.	.52	00	51
293	A. Petre, Ft. Smith.	Hearts	none.	present	.22	00	63
294	A. Petre, Ft. Smith.	Barber Pole.	none.		.16	65	35
295	A. Petre, Ft. Smith.		none.		2.90	04	61
296	A. & J. Grier, Ft. Smith.	Mixed.	none.	present	.32	41	34
297	A. & J. Grier, Ft. Smith.	Cough Drops.	none.	present	.25	69	29
298	A. & J. Grier, Ft. Smith.	Horehound.	present		.07	82	08
299	A. & J. Grier, Ft. Smith.	Jelly Cake.	present	present (two kinds)	.48	36	59
300	A. & J. Grier, Ft. Smith.	Marshmallow	none.		.69	78	24
301	A. & J. Grier, Ft. Smith.	Marshmallow	none.	present	.55	64	32
302	A. & J. Grier, Ft. Smith.	Peanut	none.		.88	64	09
303	Brun Bros., Ft. Smith.	Lemon and Mint.	present		.27	66	34
304	Brun Bros., Ft. Smith.	Molasses.	none.		.89	70	23
305	Brun Bros., Ft. Smith.	Raisin Fig.	present		1.38	63	30

CANDY.—CONTINUED.

SAMPLE NO.	RETAILED BY	KIND.	STARCH.	COAL TAR DYE	% OF ASH.	% OF CANE SUGAR.	% OF GLUCOSE.
306	Brun Bros., Ft. Smith.	Taffy.	none.	none.	.10	68	27
307	Brun Bros., Ft. Smith.	Peanut	none.		.64	56	21
308	Brun Bros., Ft. Smith.	Gum.	present	present	.39	53	29
309	Brun Bros., Ft. Smith.	Taffy Cream.	none.		.30	22	18
310	Brun Bros., Ft. Smith.	Taffy Strawberry.	none.		.21	65	01
311	Brun Bros., Ft. Smith.	Cocoanut.	none.	none.	.42	48	27
312	Tony Marre Racket Store, Ft. Smith.	Gum.	present	none.	.53	00	51
313	Tony Marre Racket Store, Ft. Smith.	Banana.	present	none.	.00	52	17
314	Tony Marre Racket Store, Ft. Smith.	Fudge.	none.	present	.60	50	40
315	Tony Marre Racket Store, Ft. Smith.	Cocoanut.	present	present	.48	25	31
316	Tony Marre Racket Store, Ft. Smith.	Peanut	none.		.76	37	27
317	Tony Marre Racket Store, Ft. Smith.	Eggs.	none.	present	.21	55	30
318	Tony Marre Racket Store, Ft. Smith.		present	none.	.00	43	15
319	Tony Marre Racket Store, Ft. Smith.	Cocoanut.	present	none.	.94	38	24

Thirteen samples contained starch, eleven coal tar dyes and all contained glucose. None contained saccharin and all but one contained either lime or alum. All samples were purchased during the Christmas holidays, 1904.

PICKLES.

Number 347. Acme, Olympic style, 10 cents per bottle. Packed by The J. Weller Co., Cincinnati, Ohio. Retailed by Gilbreath & Taylor, Fayetteville, April 1, 1905. Contained saccharin but no preservatives or copper.

Number 348. Highly Spiced, 10 cents per bottle. Packed by The North Side Preserving Co. Retailed by Gilbreath & Taylor, Fayetteville, April 1 1905. Contained no preservatives or copper.

BEER.

Number 349. Original Budweiser from Anheuseur-Busch, St. Louis. Contained 6.10 per cent. alcohol, but contained no preservatives.

SUGAR GRANULATED.

SAMPLE NO.	RETAILED	DATE OF PURCHASE.	% OF ASH.	% OF CANE SUGAR.	% OF GLUCOSE
351	Gilbreath & Taylor, Fayetteville.	April 5, 1905.	.00	97.3	1.0
352	Thomas Grocer Co., Fayetteville.	April 5, 1905.	.00	95.9	2.1
353	C. C. Conner & Co., Fayetteville.	April 5, 1905	.00	95.8	2.1
354	Bates Bros., Fayetteville.	April 5, 1905.	.00	100.0	0.0
355	Lewis & Sharp, Fayetteville.	April 5, 1905.	.00	97.8	1.3
356	Eason Bros., Fayetteville.	April 5, 1905.	.03	96.6	1.5
357	J. S. Lackey, Fayetteville.	April 5, 1905.	.07	97.4	2.3
358	Lantrip & Miller, Fayetteville.	April 5, 1905.		96.7	1.9
359	Burk Grocery Co., Fayetteville.	April 5, 1905.	.11	96.0	1.7

Eight out of the nine samples contained some glucose. None contained sulphites or an appreciable amount of ash. The U. S. standards require that granulated sugar shall contain at least 99.5 per cent cane sugar.

HONEY.

SAMPLE NO.	360	361	362	363
Packed by	Hyde Bee Co., Floresville, Tex.	Dodson-Braun, St. Louis.	St. Louis Syrup and Preserving Co., St. Louis.	
Retailed by	Gilbreath & Taylor, Fayetteville.	Gilbreath & Taylor, Fayetteville.	Gilbreath & Taylor, Fayetteville.	Thomas Grocer Co., Fayetteville.
Date of Purchase	April 5, 1905.	April 5, 1905.	April 5, 1905.	April 5, 1905.
Brand	Pure Texas.	Cupid.	Fancy.	
Sulphites......	none.	none.	present.	none.
% of water.....	19.51	25.39	20.87	20.05
% of ash......	1.73	.04	.37	.00
% of cane sugar	1.50	3.30	1.90	3.00
% of glucose..	0.00	16.40	72.10	.00

The United States standards require that honey be laevo-rotary, contain not more than 25 per cent. of water, not more than .25 per cent. of ash, and not more than 8 per cent. of sucrose (cane sugar).

No. 360 exceeded the limit in ash and both 361 and 362 contained glucose.

MOLASSES.

SAMPLE NO.	364	365	366	367
Packed by	Penick & Ford, Shreveport, La.	Maury-Rawlings Co., White Castle, La.	St. Louis Syrup and Preserving Co., St. Louis.	
Retailed by	Gilbreath & Taylor, Fayetteville.	Gilbreath & Taylor Fayetteville.	Eason Bros., Fayetteville.	Thomas Grocer Co., Fayetteville.
Date of Purchase	April 5, 1905.	April 5, 1905.	April 5, 1905.	April 5, 1905.
Brand	Old Fashioned	Old Time.	Octavia.	Country.

MOLASSES.—CONTINUED.

SAMPLE NO.	364	365	366	367
Sulphites	trace.	present.	trace.	none.
% of water	31.37	30.34	23.16	25.33
% of ash	2.49	1.56	1.16	3.60
% of cane sugar	36.80	41.90	9.30	48.10
% of glucose	7.50	14.90	73.50	1.10

The United States standards require that molasses shall not contain more than 25 per cent. of water, nor more than 5 cent. per of ash. Three of the four samples exceeded the limit on water while the other was mostly glucose with some sulphites.

SYRUPS.

SAMPLE NO.	368	369	370	371
Packed by	Corn Products Co., Chicago.	St. Louis Syrup & Preserving Co., St. Louis.	C. C. Conner & Co., Fayetteville.	New Orleans Coffee Co., New Orle's.
Retailed by	Gilbreath & Taylor, Fayetteville.	Gilbreath & Taylor, Fayetteville.	C. C. Conner & Co., Fayetteville.	Bates Bros., Fayetteville.
Date of Purchase	April 5, 1905.	April 5, 1905.	April 5 1905.	April 5, 1905.
Brand	Karo.	Fancy Table.	Silver Drip.	Evaporated Sugar Cane
Sulphites	present.	present.	present.	present.
% of water	3.55	25.50	23.23	30.38
% of ash	.75	.45	.51	2.46
% of cane sugar	5.90	.40	2.40	29.50
% of glucose	76.60	91.20	92.90	29.40

SYRUPS—CONTINUED.

SAMPLE NO.	372	373	374	375
Packed by			Evins-Wilson Grocer Co., Fayetteville.	Fayetteville Grocer Co., Fayetteville.
Retailed by	Thomas Grocer Co., Fayetteville.	Thomas Grocer Co., Fayetteville.	Bates Bros., Fayetteville.	Gilbreath & Taylor, Fayetteville.
Date of Purchase	April 5, 1905.	April 5, 1905.	April 5, 1905.	April 5, 1905.
Brand	Ribbon Cane.	Rock Candy	Rock Candy Drips.	Honey Drips.
Sulphites......	present.	none.	present.	present.
% of water....	32.77	33.43	23.75	18.15
% of ash......	.89	.09	.84	.43
% of cane sugar	57.50	64.70	2.00	3.60
% of glucose...	1.40	1.90	67.10	83.70

SAMPLE NO.	376	377	378	379
Packed by	C. W. Goyer, Memphis, Tenn.	Eddy & Eddy, St. Louis.	St. Paul Syrup Refining Co., St. Paul, Minn.	The Towles Maple Syrup Co., St. Paul, Minn.
Retailed by	C. C. Conner & Co., Fayetteville.	Thomas Grocer Co., Fayetteville.	Gilbreath & Taylor, Fayetteville.	C. C. Conner & Co., Fayetteville.
Date of Purchase	April 5, 1905.	April 5, 1905.	April 5, 1905.	April 5, 1905.
Brand	Goyer's Maplecane	Maple (from bulk)	Maple Canada Sap.	Maple Log Cabin
Sulphites......	present.	none.	none.	none.
% of water....	24.30	30.79	31.03	32.23
% of ash......	.21	.09	.15	.20
% of cane sugar	7.50	67.50	63.80	62.00
% of glucose...	64.30	1.40	.70	2.30

For the twelve samples analyzed seven contained a high per cent. of glucose eight contained sulphites and all of the four labeled maple had undoubtedly been adulterated with refined sugar as shown by the low ash content.

MAPLE SUGAR.

SAMPLE NO.	RETAILED BY	DATE OF PURCHASE.	SULPHITES.	% OF WATER	% OF ASH.	% OF CANE SUGAR.	% OF GLUCOSE.
380	C. C. Conner & Co., Fayetteville.	April 5 1905.	none.	4.68	1.45	87.1	.00

The sample of maple sugar was probably pure but of poor quality.

VINEGAR.

SAMPLE NO.	381	382	383	384
Producer	Fayetteville Grocery Co. Fayetteville.	Fayetteville Grocery Co., Fayetteville.		Dodson-Braun, St. Louis.
Retailed by	Bates Bros., Fayetteville.	Gilbreath & Taylor, Fayetteville.	C. C. Conner & Co., Fayetteville.	C. C. Conner & Co., Fayetteville.
Date of Purchase	April 10, 1905.	April 10, 1905.	April 10, 1905.	April 10, 1905.
Brand	Apple Cider	Apple Cider	Apple Cider	Apple Cider
Prices in Cents per Gallon.		.30		.25 per bottle.

SAMPLE NO.		381	382	383	384
Specific rotation		laevo.	laevo.	laevo.	laevo.
100 cubic centimeters of the samples contained in grams.	Acetic acid	3.10	3.04	2.26	4.80
	Solids	.32	.37	2.38	2.47
	Ash.	.06	.07	.50	.50
Number of cubic centimeters of deci-normal acid required to neutralize the water soluble ash from 100 cubic centimeters of the sample.		1.60	1.60	28.00	13.50

VINEGAR—CONTINUED.

SAMPLE NO.	385	386	387
Producer	Hamilton, Fayetteville.	From country.	Louisville, Ky.
Retailed by	Lantrip & Miller, Fayetteville.	Burch Grocery Co., Fayetteville.	Thomas Grocer Co., Fayetteville.
Date of Purchase	April 10, 1905.	April 10, 1905.	April 10, 1905.
Brand	Apple Cider	Apple Cider	White Wine
Price in Cents per Gallon.	.25		

SAMPLE NO.		385	386	387
Specific rotation		laevo.	.00	.00
100 cubic centimeters of the sample contained in grams	Acetic acid	4.19	2.94	10.03
	Solids	5.14	.44	.24
	Ash	.50	.07	.02
Number of cubic centimeters of deci-normal acid required to neutralize the water soluble ash from 100 cubic centimeters of the sample		8.80	1.30	.40

The United States standard for apple cider vinegar is that it shall be laevo-rotary, and contain not less than four grams of acetic acid, not less than one and six-tenths grams of apple solids, and not less than twenty-five hundredths grams of apple ash in one hundred cubic centimeters. The water soluble ash from one hundred cubic centimeters of the vinegar shall require not less than thirty cubic centimeters of deci-normal acid to neutralize the alkalinity.

Not one of the six sold as pure apple cider vinegar came up to this standard four were deficient in acetic acid, three were deficient in apple solids, three deficient in ash and all were deficient in the alkalinity of the ash. In other words, none of them were straight cider vinegar.

SODA FOUNTAIN SYRUPS.

Ten samples (lemon, vanilla, claret, raspberry, root beer, pine apple, wild cherry, strawberry, orange and ginger ale), were purchased of A. J. Mitchell, Fayetteville, April 14, 1905. None contained preservatives or saccharin, but all were artificial syrups. Claret, raspberry, wild cherry and orange, each contained coal tar dye.

SUMMARY OF ANALYSES.

KIND.	NUMBER ANALYZED	NUMBER PURE	NUMBER IMPURE.	% PURE.	% IMPURE.
Canned peas	25	16	9	64	36
Canned corn	11	11	00	100	00
Canned beans	15	15	00	100	00
Mince meat	7	5	2	71	29
Canned tomatoes	11	9	2	82	18
Canned pears	7	5	2	71	29
Canned peaches	18	15	3	83	17
Canned apricots	6	6	00	100	00
Canned strawberries	2	1	1	50	50
Canned blackberries	2	00	2	00	100
Canned raspberries	1	1	00	100	00
Canned apples	1	1	00	100	00
Canned grapes	1	1	00	100	00
Canned plums	2	2	00	100	00
Canned cherries	3	2	1	67	33
Canned gooseberries	1	1	00	100	00
Canned squash	1	00	1	00	100
Canned hominy	2	00	2	100	00
Canned mushrooms	2	1	1	50	50
Canned asparagus	3	3	00	100	00
Canned pumpkin	3	3	00	100	00
Canned pineapple	6	6	00	100	00
Meat	49	44	5	90	10
Catsup	14	1	13	7	93
Sauces	9	6	3	67	33
Dried fruit	7	2	5	29	71
Dairy products	2	1	1	50	50
Baking powders	13	2	11	15	85
Jellies	18	6	12	33	67
Preserves	17	00	17	00	100
Jams	14	3	11	21	79
Candy	32	12	20	38	62
Pickles	2	1	1	50	50
Beer	1	1	00	100	00
Sugar	9	1	8	11	89
Honey	4	1	3	25	75
Molasses	4	1	3	25	75
Syrup	12	1	11	8	92
Maple sugar	1	1	00	100	00
Vinegar	6	00	6	00	100
Soda fountain syrups	10	00	10	00	100
Total	354	188	166	53	47

RICE GROWING IN ARKANSAS.

By W. G. Vincenheller.

INTRODUCTION.

Experiments in rice growing in Arkansas were begun on a limited scale by the Arkansas Experiment Station in 1902 near the town of Lonoke, Lonoke County. This experiment was in cooperation with a resident farmer to whom credit is due for the idea of rice growing in the prairie section. A good stand of rice was secured from the first sowing and the crop proved promising, but as the facilities for irrigation were crude and inadequate the yield was disappointing except on a small area near the well. This experiment, however, was sufficient to demonstrate that rice would succeed on the prairie lands under irrigation.

In 1903 the Director of the Experiment Station took the matter up with the Department of Irrigation and Drainage at Washington, asking its aid and cooperation. An expert was sent down by the Department, under whose direction a well was sunk, machinery installed and levees constructed. A crop of about ten acres was planted in the spring of 1904. Although the plant was not sown till late the experiment was a success from the beginning, one plat yielding 75 bushels per acre.

In 1905 the plant was increased to about 30 acres. Heavy rains prevented fall plowing and greatly retarded the work of throwing up levees. Rains continued in the spring so that the sod land was not turned till April 26th and the stubble was not finished till April 30th. The land was then disced three times to pulverize the clods.

No seed drill being available seed was sown broadcast, by hand, followed by smoothing harrows. The amount used was 1¼ to 1½ bushels per acre. A good stand was in most places secured.

Weeds soon made their appearance on the plats that had been cultivated the previous year, but as the plants had made a good start weeds were destroyed by flooding the crop.

It should be stated that owing to wet weather it was impossible to plant the crop at the proper time. This caused some light heads in the latest planting. Frequent showers in August, followed by cool nights prevented pollination on some of the plats, as will be shown later.

The following table will show the date of planting, flooding, harvesting, etc.:

Plats.	Acres.	Variety.	When planted.	Water turned on.	Water turned off.	When harvested.
No. 1	3	Honduras	May 6.	June 9	Sept. 12	Sept. 25,26
No. 2	10.93	Honduras	May 20-24	June 19	Sept. 25	Oct. 5
No. 3	3	Honduras	May 24-25	....	....	Oct. 6
No. 4	6.97	Japan	May 26	June 30	Oct. 4	Oct. 16
No. 5	2	Japan	May 29	June 30	Oct. 4	Oct. 17
No. 6	2.1	Japan	May 31	June 30	Oct. 4	Oct. 17

Continuous rains stopped the work on the levees of plat 3. They were never finished so the water would stand the proper depth over the entire plant, hence it was intended to plow up that field and seed to some other crop. This could not be done for some time. The field was therefore filled to the full capacity of the levees by rains. As the rains continued, thus furnishing fresh water every few days, the yield on that plat was fair.

The "showery" season of August, followed by excessive cool nights, prevented pollination on plat 5, and one acre of plat 6. This "light rice" was therefore cut for feed in the sheaf. Considerable trace of red rice was also found in plat 5, which necessitated early cutting for stock feeding. The following table gives the yield:

Variety.	Yield, pounds.	Yield, bushels.	Yield, barrels.	Acres.	Max. to acre.	Min. to acre.	Average, bushels.
Honduras ..	39,600	900	244.4	16.93	60	35	53
Japan	23,980	545	148.6	8.07	100	40	67.53
Total	63,580	1,495	393.0	25.00	...	..	57.8

It will therefore be seen that only 25 acres were threshed and the average yield to acre was 57.8 bushels.

The following table shows successful growers of rice in Lonoke in 1904.

Name of Grower.	Acres.	Size of Well.	Horse-power of Engine.	Yield.
Jacob Branstine....	100	10 inches	25	5,000 bu.
B. Fhromholtz.....	40	10 inches	..	1,800 bu.
W. H. Fuller......	30	10 inches	25	....
Loyd Robinson.....	120	10 inches	25	4,500 bu.
Elmer Robinson....	90	10 inches	25	....
D. B. Perkins......	55	10 inches	16	....

HISTORY.

Rice is an annual plant, belonging to the great family of grasses. It is known botanically as *Oryza sativa bengalensis.* The cultivation of this plant antedates authentic history. It was very early connected with the tradition and mythology of primitive Asiatic nations. Rice is probably a native of southeastern Asia, although first cultivated by the Chinese. It was known to the early Greeks and Romans, and formed a very important article of their commerce.

The first rice in the United States was grown by Sir William Berkley in 1647. In his address in 1694 Governor Alston of South Carolina says, "Rice, for which we are indebted to Madagascar, was introduced into South Carolina toward the close of the 17th century."

Rice has been selected as the chief article of food in China, Japan, India, and almost all other countries of dense population where the people are dependent upon the cheapest rations. Leguminous plants which grow luxuriantly at all seasons in tropical countries, furnish the nitrogenous food element. In fact, rice and peas and beans, is a much cheaper, complete food, than wheat and meat, used by Europeans and Americans.

GENERAL SUGGESTIONS.

Varieties.

A great many varieties of rice are known, many differing in nutrition, length of season for maturity, yield, etc. One hundred and sixty-one varieties are described in Ceylon, and in China and Japan, where it has been the staple crop for centuries, and where great care is used in seed selection, there are said to be 1,400 varieties.

This station has cultivated two varieties: Honduras, named for the country from which the seed came, and Japan, a hardy variety recently introduced from that country by the Department of Agriculture.

The Japan has a short, thick kernel, a thick hull and heavy grain. It is not so tall as the Honduras and the straw is smaller and green when the grain is ripe. The percentage of bran in the Japan is small. Since the grains do not break so badly it will mill more head rice than the Honduras. The market price for Japan, however, is a little less than for Honduras, but the yield is greater.

The Honduras has a large grain, a tall stiff stalk, and is not so easily blown down. Both varieties have their advantages and disadvantages. Our experiments, based upon two years' tests, proved that Japan is well adapted to our soil and climate. Japan may be planted later than Honduras, with good results.

SOIL.

The soil at Lonoke, commonly known as the Prairie Longue district, is a low, level prairie. The texture is close and stiff, underlaid by an impervious sub-soil which forms a hardpan, making almost ideal conditions for irrigation. These peculiar conditions cause the soil to hold water, greatly economizing the amount necessary for irrigation; when turned off it soon dries, allowing the use of the binder. Experience has proved that an inexhaustible supply of water can be obtained at a distance of 100 to 180 feet. The land is so nearly level that there are no expensive levees or deep canals. It is probable that rice can be grown on any lands in southern Arkansas which can be successfully irrigated. So far no experiments have been made on the alluvial lands of the bottoms, but where irrigation is practical and drainage good rice should succeed.

The best soil for rice is a medium loam with about fifty per cent clay. This allows enough humus for the greatest fertility, and at the same time makes it sufficiently compact.

Sandy or gravelly soils are not recommended for rice because they do not ordinarily possess the mechanical conditions to contain water.

PREPARING THE SOIL.

The soil should be prepared by deep plowing, followed by the disc and smoothing harrows. Some farmers advocate shallow plowing upon the supposition that rice thrives best in a compact soil, but this does not prove that deep plowing is not preferable. Annual cultivated plants do not usually feed deeper than the land has been plowed. Rice lands, except where cultivated in drills, receive no cultivation after the crop is planted, hence the plowing should be deep. Granting that the plant requires compact soil deep plowing, following by the harrow and the roller, usually make a good seed bed.

Whether the land should be plowed in the fall or spring will depend upon the soil, location, etc. Fall plowing on most soils has the advantage of spring plowing. In the former case, winter freezes disintegrate organic matter, making a supply of humus so necessary for the rice plant. The soil is then mellow and ærated for spring sowing. Much depends upon the preparation of the land before sowing.

PLANTING.

Time of planting will largely depend upon the season. In southern Arkansas it may be said that the earlier the crop is planted the better after all danger of frost is over and the ground is warm enough to germinate the seed. This will usually be from April 1st to May 15th. Honduras should be planted earlier than the Japan so it will pass safely through the showery season so fatal to pollination. Early rice is usually harvested before the fall rains and storms.

Some farmers plant several fields at different times so each may be reaped when ready. In general it may be said that the amount to the acre is from one to two bushels. Usually one and one-fourth bushels is sufficient.

Planting may be done with the seed drill or by hand. It is usually better to plant with the drill as the seeds are more uniformly distributed both in depth and distance apart. It is often the case that rice lands are badly drained and must therefore be planted while wet. It is not infrequently planted in mud and water. As a result of this the seeds often are tramped in the mud by horses and buried too deep. Pains should be taken to have the ground in good condition as a great deal depends upon a good stand and uniform ripening.

FLOODING.

As above mentioned, the geological formation of the prairie region of Arkansas is such that an abundant supply of soft water can be had at a depth of from 100 to 180 feet. There is a gravelly stratum at varying depths that forces the water to the surface, making pumping practical. No experiments have been made so far, but it is the general supposition that artesian water can be had at a greater depth.

Levees are thrown up with a plow or spade, sometimes with a V shaped drag. Usually the main levees are broad so they are not so easily broken by freshets or leaks caused by crawfish. Broad mains permit the binder to pass over, and may be used from year to year. Cross levees can be easily made with a plow, a few furrows being all that is necessary. Care must be exercised to have the water as near as possible the same depth over the field to secure uniform ripening. Rice growers differ in opinion as to the depth the water should be kept on the field, but in general it may be said that the ground should be kept covered with water. No matter how nearly level the land may seem, it is always more or less undulating, or high places are present, that necessitate many cross levees. These cross levees may be plowed down so that the binder may pass over when the rice is ready to harvest.

In case the soil is extremely dry the water may be turned on to germinate the seed. In that case the water should be turned off as soon as the seed sprout, or there will be danger of scalding the tender plants.

Showing height and stand of rice and irrigating canal.

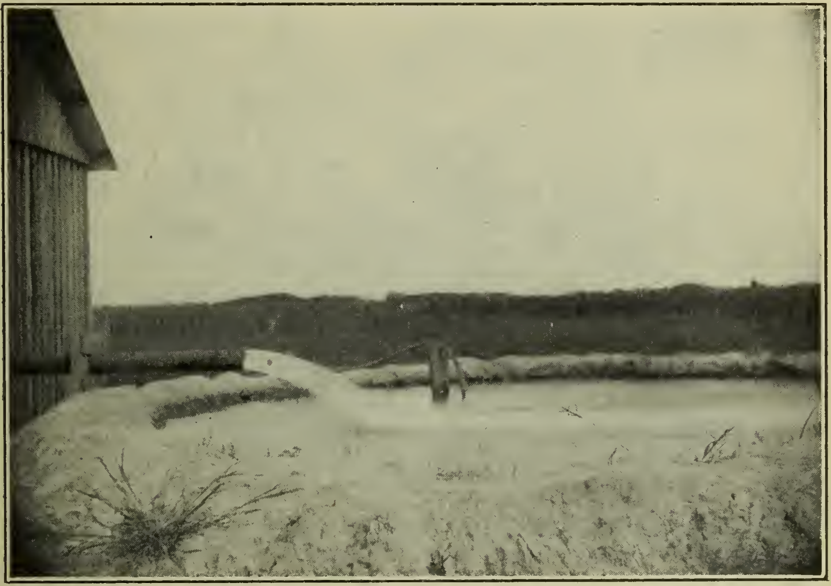
When the plants are six or eight inches high the water is turned on and kept on continuously till from ten to fourteen days before it is ready to harvest. Fresh water must be pumped at least every ten days as stagnant water is fatal to the plant. The flooding period ranges from 70 to 100 days.

Rice requires air and sunshine, as well as moisture, hence the water should not be too deep. It has been claimed that if the water is too deep the maturity of the grain is retarded.

An abundant supply of water is imperative for rice growing. No grower should plant his crop or purchase his machinery till the supply of water for irrigation is assured.

WEEDS.

Except "red rice" there are as yet no noxious weeds in the rice fields of Arkansas. Red rice is already making its appearance and unless great care is exercised in the selection of seed and the proper methods employed in managing the field after the crop has been removed, it will prove a serious menace to rice growing. The loss to the Louisiana and Texas growers has been very great, yet this could have been obviated if care had been taken to select pure seed.



Showing output of water from irrigating well.

Red rice is truly a "weed," and must not be confused with the cultivated red rice extensively grown in South Carolina, and elsewhere. This plant is probably a native of India, where it still grows wild. It has found its way into the fields of China and Japan and the United States and almost every other country where rice is cultivated. It is a distinct variety if not a distinct species, from the white rice. Growers at one time believed that it germinates from the white rice left in the ground through the winter. This theory still exists, but the more observant have long since abandoned that idea. It is a separate and distinct variety and the seed of the one cannot produce the other. Dr. S. A. Knapp (Bul. 22, U. S. Dept. Agr.) thus describes the red rice, *Oryza sativa rufipogon*: "Red rice is so called from the red color of the grains. In most cases the grain is colored a dark red through the entire substance. In other instances, seeds may present any shade of color between the red and the white; again, only the seed coat contains the coloring matter, and in this case the grain comes from the mills clean and white, or little stripes of red where the coat has been imperfectly removed.

"The leaves of the variety rufipogon are larger than the cultivated form. The infloresceense is longer, more slender, copiously branched, forming an erect head like some forms of Johnson grass. The heads bear fewer and smaller grains, the receptacle at the end of the pedicle just below the grain is thick and short, with ear-like rings. The white rice, or cultivated form, *Oryza sativa bengalensis,* produces a plumper, more rounded grain and spikelet, borne on a larger pedicle, the receptacle of which is only slightly distorted. The panicles are less erect."

Red rice is a vigorous, persistent plant, and when once established in the fields is very hard to eradicate. Food value of the red rice is about equal to that of the white, but the grains of the former are soft and brittle and break in process of milling. A few grains of red in a sack greatly reduces the market price.

The grower should see that no red is planted. It is much easier to prevent its getting a start than to destroy it after it is established in the fields. Should a suspicious plant be found growing on the levees or in the fields it should never be allowed to mature seed. When once the fields are contaminated with this weed the only way to eradicate it is to let the field lie fallow, or if sufficiently drained sow to oats followed by cowpeas, or cultivate to some crop as cotton or corn.

The ordinary grasses and weeds that germinate the first few years are easily destroyed by flooding the rice. Rice soon shades the ground and chokes out any weed of ordinary persistence.

HARVESTING.

The grain should be cut before it is too ripe. It is usually cut while in the "dough" stage. This makes the grain tough and therefore greatly reduces breakage, which is usually heavy, in milling.

The prairie lands of Arkansas are well adapted to improved machinery, the self binder. This enables the grower to plant a large crop and reduces the expense in purchasing machinery.

The grain is usually cut from six to twelve inches high and shocked immediately after the machine. Great care must be used in shocking or much injury will be sustained by rain and storms. The following timely advice is given by Dr. Knapp (Bul. 22 U. S. Dept. Agr.).

Showing rice and pumping plant.

"First shock on dry ground; second, brace the bundles carefully against each other so as to resist rains or storms; third, let the shock be longest east and west, and cap carefully with bundles, allowing the heads of the capping bundles to fall to the north side of the shock to avoid sun. Exposure of heads to the sun is a large factor in producing sun cracked and chalky kernels, which reduce the milling value.

Slow curing in the shade produces that toughness of kernel necessary to withstand milling. In the shock every head should be shaded and sheltered from the storms as much as possible. The rice should be left in the shock till the straw is cured and the kernel hard."

Whether or not it will pay to stack the grain is a question that each grower must settle for himself. Whether or not it is practical will depend upon the season, condition of the grain, and how the stacking is done. If too much heat is generated stacking may prove a positive injury. There is always much loss in hauling or moving rice in the sheaf and it is doubtful whether it ever pays to stack. If the crop is planted early it should be reaped at a season when the weather is favorable and shocking would be sufficient.

THRESHING.

Primitive methods of ''flailing'' or pounding out the grain are still practiced by oriental peoples, but thanks to inventive genius the steam thresher and separator is now commonly used. Of course there is some loss in breaking the grains, but few will deny the thresher a boon to rice growers.

Threshing and loading.

The grain is hauled from the shock or stack to the machine. After it is separated from the chaff and straw it is sacked and ready for the mill, as ''paddy'' or rough rice.

DUTY OF CENTRIFUGAL PUMP FOR IRRIGATION, LIFTING WATER LESS THAN 35 FEET.[1]

Diameter of Discharge, inches.	Discharge, per minute,[2] gallons.	Power required for each foot lift, horse-power.	Quantity pumped, per day, acre, feet.	Area irrigated in 70 days, acres.
4	435	.27	1.87	60
6	1,085	.56	4.53	158
8	1,900	.98	8.39	294
10	3,000	1.54	13.25	464
12	4,275	2.06	30.93	1.083
18	10,000	4.62	44.19	1,547
20	13,000	5.68	57.45	2,011

[1] Bond and Keeney, (Bull. 113 U. S. D. A.).

[2] Discharge completed from velocity of 12 feet per second in discharge pipe.

The result of this experiment has proven the adaptibility of this section of the state to profitable rice growing. The stimulus had been so great among the farmers that from three to five thousand acres will be planted this year, 1906.

THE CATTLE TICK

IN WASHINGTON AND BENTON COUNTIES.

By W. G. Vincenheller.

Federal quarantine: When the quarantine line or boundary between the "ticky" and non-ticky region, as we now regard it, was determined by the Agricultural Department about fifteen years ago, some eighteen counties along the northern line of Arkansas were exempted from quarantine restrictions. It was found that these counties were free from Texas fever infection and consequently cattle could be shipped or driven from these counties without endangering the stock further north. Since that time we have learned that the presence or absence of ticks (cattle ticks or "Texas ticks") is the best indication of whether or not a region is infected.

A State quarantine law defining a "district cattle quarantine line" in Arkansas was enacted in 1899, this quarantine line corresponding to that of the federal government. It is still in force and is published in full in bulletin No. 82.

For some years past the federal quarantine has been enforced against the whole State, the above named counties, however, being allowed the privilege of shipping cattle (not for slaughter) after inspection by Government inspectors. As a matter of fact this inspection is seldom called for, few cattle being shipped north from this region except for immediate slaughter.

Object of quarantine: The reason for this restriction on the movement of stock from Arkansas is to prevent the introduction and spread of Texas or Splenic fever, or in other words, as we now understand it, to prevent the introduction of cattle ticks into territory hitherto clear of them. It is now so well known that fatal disease is caused by these ticks that further comment on this matter is not called for here.

Missouri also protects her territory from Arkansas ticks by a special cattle quarantine law, as also do other adjoining States which are naturally free from ticks. In these States the quarantine is not a paper law only, but is enforced rigidly since the farmers are alive to the need of such protection.

Just how the presence of cattle ticks reacts harmfully (if not ruinously) to the livestock industry of a region like Northwest Arkansas, will be explained later on.

State quarantine law: Reference has been made to this law above. It was enacted in 1899 for the purpose of preventing the introduction of cattle ticks into these northern counties of the State. Two tiers of counties along the northern boundary of the State were at one time practically free from ticks as a permanent thing, although subject to temporary infection at times by the driving of cattle from further south. The State cattle quarantine law was for the purpose of preventing this occasional tick invasion from becoming permanent, so that the northern counties of Arkansas might have the immense advantage of being north of the government quarantine line. It has not succeeded in this intent, (1) because the law is in various ways defective, but especially in failing to provide for its own enforcement; and (2) because the farmers generally were not alive to its necessity and failed to assist in enforcing the law. Unfortunately this condition still exists throughout most of the section referred to, but in some of these counties the most intelligent and influential farmers have come to appreciate the situation.

Washington and Benton Counties: These two counties are located north of the State quarantine line and originally were not included in the government quarantined region, but practically are under quarantine now, as above explained. Cattle shipped to St. Louis or Kansas City for slaughter go into the quarantine, or southern cattle pens, a location which does not improve their chances for profitable sale.

These two counties have, in general, been free from cattle ticks. Although subject to occasional invasion, in limited areas, each summer, by tick-bearing cattle from south of the mountains, the infection thus introduced seems to have died out each winter. During the last few years such instances have become more common. There has been more driving of stock from south of the mountains, ticks have been more widely spread in these counties each summer, with resulting losses from tick fever in native cattle, and, the worst feature of all, the cattle ticks now seem to live over from one season to another. This means that these counties are in danger of becoming permanently tick-infested and cattle raising of becoming even more unprofitable than it is now.

Source of infection with ticks: In the two counties referred to the increased infection of late years has been due to the annual spring migration of berry pickers, some of whom from south the mountains bring their cattle stock with them. A few ticks brought in this early in the year may cause wide-spread infection since there is time enough during the summer for at least two generations, or crops to hatch, thus increasing their numbers a million-fold or more. Part of the infection prevalent in Washington County last summer and the summer of 1904 was easily traced to this source.

Another source well known to farmers north and west of Fayetteville who lost cattle during both 1904 and 1905, was due to a shipment of cattle which for some reason was held up at the stock pens north of town and, as report has it, purposely turned out on to the roads. These cattle were infested with ticks which they distributed along the roads and in the open ranges south of Johnson. As a consequence, a considerable number of cattle have died in that section and the infection has now been widely disseminated. These ticks, according to the evidence, survived the winter of 1904-1905 and most probably will be ready for business again in 1906 on a greatly enlarged scale.

The two sources of infection just named have admittedly been the cause of comparatively large losses to some farmers in this neighborhood, who could least afford it, and the chances are that these losses will be still greater in the future.

Were they preventable? Just as easily as practically all the yearly losses in these northern counties from the same cause could be prevented, simply by enforcing the state quarantine law which forbids the movement of cattle from south of Washington County during the months from March 1, to November 15, under a penalty of $200 to $500 for each offense. The duty of preventing violation of this law is placed upon any ''peace officer'' who may learn of such violation (Act. LIX Sec. 4, 5, 6, 1899). That no prosecutions under this Act have ever been heard of is not surprising since the farmers themselves have shown no interest in this matter. No ''peace officer'' is likely to take the initiative in a matter of this kind unless pushed to his duty by those for whose benefit the law was enacted.

The present condition in most of the northern counties of Arkansas, of which Washington and Benton Counties have been taken as examples, is one of partial infection, some few sections only being tick-infested; hence, the task of clearing these counties of ticks will be easier now than any time in the future. The *need* for this work will best be realized by a study of the disadvantages under which agriculture labors in tick-infested regions, and of which the whole southern United States furnish the example.

A summary of these is all that can be given here:

Animal husbandry is the basis of all successful farming in any region. This is so elementary a maxim in agriculture that it should require no explanation. Cattle raising (and dairy husbandry where practicable) from this point of view, is the most important branch of animal husbandry, hence whatever renders this unprofitable places the farmers of such a region under an enormous disadvantage. The prevalence of cattle ticks in any region operates against successful cattle raising in various ways:

(1) Where numerous, they interfere with growth (independent of their disease-carrying action), in the young, which results in permanently stunted growth, a fact well known to all breeders of pure bred cattle in the south;

(2) In regions partially infected they cause numerous losses each summer from Texas, or "Tick Fever."

(3) Tick-infested regions are under quarantine by the federal government and by adjoining State governments. Cattle cannot be moved north for feeding purposes, but only for slaughter at the city markets, and in addition are placed in the quarantine pen, which, according to a prevalent belief, knocks off anywhere from one-fourth to one cent per pound from their selling price on foot.

(4) If sold locally for butchering purposes the farmer has to take what is offered him, which frequently is less than the cost of raising the animal. Under such burdens as these it is not surprising that cattle raising in north Arkansas is at a low ebb. It is worse in the two northwestern counties than further east on account of the more limited open range, because on the open range, which is the Arkansas way of raising stock, the cattle are raised cheaply even if they are of little value, and cheapness, not quality, is the object aimed at. The advantages of having a region free from tick infection and consequently of quarantine regulations, are obvious from what has been said above. It is no exaggaration to say that until these conditions are obtained farming on the worn out, upland soil must be a

losing game, and even on bottom land cannot be permanently prosperous.

The disadvantages above referred to apply to the whole State (and in fact to all the southern States) with this exception, that south of the state quarantine line cattle are generally immune to Texas fever, and losses (deaths) from this cause are uncommon, while in the counties along the northern boundary this source of loss is the most obvious of all. It is in these counties, therefore, that the farmers have the greatest need of remedying this evil if it can be remedied. The situation is well illustrated by the statement of a well known Washington County farmer, formerly engaged in raising pure-bred beef stock. In answer to the question why he had relinquished the business, he stated that he was "unable to sell his stock north on account of federal quarantine, and could not sell south on account of their susceptibility to tick fever." The farmer here who raises common stock is in the same condition. He has no proper market either north or south. He is prevented by federal and state laws from selling his cattle as feeders in Missouri, Kansas, or other States, where corn is cheap, and is unable to fatten them himself on account of the high price of corn. The cattle, therefore, go to the local market, which is no market at all, or they go to the quarantine pen on the St. Louis market in an unfit condition, and command the lowest prices going. The following letter illustrates this point and shows also the discrimination in price against Arkansas cattle in the usual poor condition in which they are put on the city market:

"Kansas City, January 1, 1905.

DEAR SIR:—We are just in receipt of your favor of December 28, and carefully note contents. In reply will say, that if the cattle shipped to this market, and originating below the quarantine line are in good flesh, so that the killers will buy them, then they will sell as well in the quarantine division here as they will on the native side, but if the cattle are light weight and light flesh, so that killers do not care for them, then they are discriminated against and have to sell lower than they would on the native side, simply because stocker and feeder buyers cannot take hold of them, for they cannot send them to the native States as you know. Even should the cattle come in a thin state they will sell a little higher, at times, providing they have ticks on them, than those that have not ticks on them, for the reason that should a feeder buyer from below the quarantine line want to buy these cattle to take down there again, he would rather buy cattle with ticks on, as they would be more immune than those without ticks; but as it is only occasionally that we can find such a buyer, this does not make much difference. Stocker and feeder cattle often sell from twenty-five to fifty cents less in the quarantine division than they would in the native division, but fat cattle generally sell the same. There is no prejudice against southern quarantine cattle. The packers would just as soon have them as the native, inasmuch, as they dress out as well as the native and sometimes better. The great trouble with quarantine cattle is that they are generally so light in weight and poor quality that they meet with disfavor on that account. The demand is generally for heavier weight cattle and consequently, the natives appear to sell higher, although this is not a reality.

Yours truly,
CLAY, ROBINSON & CO."

With removal of State and federal quarantine our cattle would therefore, secure a better market; more and better cattle would be raised, and with the resulting increased fertility of the land, more corn and fruit as well.

Tick eradication: At the Annual Convention of the Commissioners of Agriculture of the Cotton States, held at Richmond, Va., in November, 1905, the following resolutions were passed:

"RESOLUTIONS RELATING TO THE EXTERMINATION OF THE CATTLE TICK PASSED BY THE ASSOCIATION OF COMMISSIONERS OF AGRICULTURE OF THE SOUTHERN STATES, NOVEMBER 1905.

Whereas, the appearance and spread of the Mexican cotton boll weevil over the entire cotton-producing areas of the United States forces upon the South a new regime in agriculture, that is, diversification; and,

Whereas, lasting success of all agriculture rests upon an intelligent and profitable animal husbandry; and,

Whereas, the entire South is admirably adapted to the production of cattle if it were not for the presence of the North American cattle tick, which makes the most profitable cattle growing upon the farm impossible; and,

Whereas, the situation concerning this cattle tick is little understood by the people that will have to contend with it in the near future, and which circumstance will lead to great losses and is likely to bankrupt many farmers;

Therefore, be it resolved by the Association of Commissioners of Agriculture of the Southern States, that we request the Congress of the United States to appropriate the sum of $500,000 to be expended under the direction of the Secretary of Agriculture in the extermination of the cattle tick (Boophilus annulatus), and in the seeking and dissemination of such knowledge that will prevent the enormous losses already suffered by the farmers of the South.

Resolved further, that this Association consider it the duty of the Commissioners of Agriculture of the quarantined states to use every effort to secure such legislation as is necessary to obtain effective cooperation between the state and federal authorities, and to use and secure in each state funds for the prosecution of its proper share of this work.

Resolved further, that copies of these resolutions be transmitted to the chairmen of the committees on agriculture of the United States Senate and House of Representatives, to the Honorable Secretary of th United States Department of Agriculture, and to the representatives of the Southern States in Congress."

At this meeting a crusade was begun with the ambitious prospect of eradicating the cattle tick from the whole southern states, and the promise of cooperation and aid was secured from the national Department of Agriculture.

Before such aid can be secured each state must take the initiative and it will now be shown in what way this can be done.

In some other states—North and South Carolina, Virginia, Tennessee, Texas and Oklahoma—this work of eradicating cattle ticks has already been successfully carried on for several years, and many counties formerly tick-infested have now been cleared and freed from quarantine. According to reports at the meeting of Agricultural Commissioners above referred to, the farmers in these counties who at first were skeptical or indifferent, are now most enthusiastic in their appreciation of the benefits resulting from the work. We may, therefore, reasonably hope for the same results in Arkansas.

Eradication of cattle ticks completely from the State of Arkansas is a task for the future, but their eradication from the northern counties could be accomplished within a few years.

It is proposed to begin this work in Washington and Benton Counties because these counties are nearest at hand, they are but slightly infested up to the present, and possess the least extent of unfenced land—all conditions favoring the undertaking.

Methods of tick eradication:—These are based upon a knowledge of the life habits of the cattle tick, the main facts of which have been known during the past ten years and described in reports from this Station. It is therefore unnecessary to repeat them here in any detail. The methods successfully employed in the states above referred to and the only practicable way of doing it, are based on the fact that cattle ticks are able to mature and propagate only as parasites on cattle or horses, and if these hosts are not accessible to them they die within a few months. Hence, if *all* cattle (and horses) are kept off a tick-infested field or open range of whatever extent during one summer, the work will be completed. This seems simple enough and is so to the farmer who wants to clean up his own fields and fenced pastures, but it presents difficulties on the open or unfenced range which can only be overcome by complete harmony and concerted action among all the stock owners of the district. Even one "rantankerous" individual by refusing to keep up his stock will defeat the whole project. As these kind of individuals exist in every community the only safe plan is to obtain an effective stock law for each county undertaking this work. This has been found a necessary preliminary step wherever the task of tick eradication has been successfully carried on.

The "general" stock law, or "no fence system" in which the farmer has to fence in his own stock instead of fencing out his neighbors' undoubtedly operates as a hardship in regions of large open range. In Washington and Benton Counties the open range is of comparatively slight extent and the sentiment apparently in favor of a general stock law even independent of this work of tick eradication.

A general stock law rigidly enforced for these two counties, even if only of two years duration, would effectually clear the open range. At the same time, those few farms which are now tick-infested could easily be cleared by individual effort of the owners, this region would then be removed from federal quarantine and the stock-raising industry have a chance for development. It is stated that in North Carolina where ten counties have been freed from ticks and federal quarantine, within the last four years an estimated annual saving of at least $24,000 has resulted from the increased selling price of exported stock alone, "which is double the entire amount expended in exterminating the ticks in those counties." "In other words, any 'stock law' county in North Carolina now under quarantine can be freed of ticks, and as a result exempted from Federal quarantine restrictions, for less money than is now lost each year solely because of the presence of the ticks.''

Federal aid has been promised (conditioned on the action of Congress in regard to appropriations) to those States which themselves make a start. Arkansas requires, as its first step, legislation establishing the ''no fence'' system in those counties desiring it. Until this is secured no thorough work can be done.

The farmer's duty is to make his wishes known to those who enact the laws for him. If the farmers of Washington and Benton Counties desire this change they can easily secure it by concerted action.

The Experiment Station desires to aid in this work as far as lies within its province. It is proposed to hold meetings throughout the two counties in order to arouse popular interest in this matter by discussion and enlightenment; this being the plan which has been found necessary in other States. Correspondence is invited from those who are willing to contribute towards the success of these meetings.

Tick eradication on the farms:—A number of farms in this section have been tick infested during last summer and fall. Farmers finding their stock on the open to be tick infested and some dying from tick fever took them off the high-ways and put them on their pastures, but neglected to first clean them of ticks. Some of these farms may be purified by the winter freezes while others will not. To cleanse an infected pasture keep off all cattle and horse stock for at least six months during summer, beginning in spring, and see that when cattle are turned on again they are free from ticks. This is best done by a system of crop rotation where otherwise practicable, two years at least being necessary for purification of a whole farm. It may also be done by using a number of small lots in which stock are fed by the soiling system, while all the rest of the farm is kept free of stock for one season. Another method recommended is to move all cattle and horse stock from tick infested fields early in fall, *not later than the middle of August* in this region. When winter comes there will be nothing living but young ''seed ticks'' which are killed by winter exposure. This plan can be used to eradicate ticks from the open country as well, and is the easiest and simplest way *if all will follow it.* But experience shows that in every community there are one or more ''kickers'' who cannot be convinced or persuaded.

This plan was recommended last summer in an Experiment Station local newspaper article for the purpose of clearing of ticks the country just north of Fayetteville. It was very generally adopted but a few individuals refused to keep their cattle up and could not be compelled to do so. Their stock may be seen on the highways even now keeping alive for the next spring and summer the infection which otherwise would have died out. This is where a stock law becomes necessary.

There are two ways of overcoming this trouble, (1) by public sentiment (if sufficiently strong and unanimous); and (2) by a stock law rigidly enforced. We need both of these means but cannot afford to wait on state legislation. Every farmer, therefore, especially where ticks and disease showed themselves last summer, should strictly keep his stock up during the coming season and by every means in his power induce his neighbor to do the same. Later on we will get the legislation.

We should aid in having the law enforced which prohibits driving cattle from south of the Washington County line and should take steps to have quarantined all cattle seen to be carrying ticks.

It may be further stated that the owners of cattle bearing ticks on their bodies are liable to damages where infection is so conveyed to other stock.

The town cow. What has been said of farm stock applies as well to cows kept in town and allowed the "freedom of the city." It often happens that the open places around town are really more dangerous than out in the country. The keeping up of town cows and their calves is therefore a necessary part of all plans for tick eradication by counties.

To free cattle from ticks:—There are three ways of doing this, each applicable under different conditions.

(1) Individual grooming with the curry comb which removes the larger ones, then washing thoroughly with an emulsion of coal oil and hot soap suds (as described in previous station reports) or greasing with a mixture of coal oil and lard. This may be used where a few head only are to be handled;

(2) *Dipping* requires a large plant and is not likely to be employed under the conditions existing here. It does not form a part of the methods now in use for thorough tick eradication;

(3) For large herds when the purpose is to clear up the pastures and ranges as well the following method is recommended: Have three small lots which are free of ticks to begin with. They will be tick

free if no cattle have been in them for a year (or in spring since August of the previous year) or they can be made tick free by plowing, burning over, etc. Put cattle for twenty-four days in each pen in succession. After the third change they will be tick free. This method is successful only in the summer months. In place of small lots pasture fields may be used but of course it leaves the fields tick infested. These can later be purified as explained above.

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SUGGESTIONS UPON THE CARE OF APPLE ORCHARDS.

By Ernest Walker, Horticulturist.

INTRODUCTION.

There is an increased interest among Arkansas growers in the better care of apple orchards, and a demand for information, or advice along the several lines embraced in that phrase, including cultivation, pruning, fertilizers, spraying, etc. This bulletin has been prepared to meet this demand, and give some results of the last season's experience in applying, on a commercial scale, the suggestions we shall offer.

Aside from mere neglect our orchards suffer more or less from ill adivesd care, based upon erroneous notions prevalent. I shall give some of these attention. It happens that in some instances intended care has worked greater mischief than outright neglect. This has been the case especially in the matter of pruning, and cultivation practiced without a full comprehension of the purposes they are intended to subserve. Much serious mischief has been met with traceable to bad pruning.

THE APPLE INDUSTRY IN ARKANSAS.

Arkansas has the distinction of embracing two counties which contain by far more bearing apple trees than any similar areas in the world. These counties are Benton, with one million six hundred and thirteen thousand three hundred and sixty-six, and Washington, one million five hundred and fifty-five thousand one hundred and forty-six.* This was five years ago. Many trees were planted after 1897 which have since come to bearing age. A vast increase in the number of Apple trees planted for commercial orchards followed the great apple crop of 1901. The number of bearing apple trees at the present time is therefore much greater than when the figures mentioned were obtained. It would be safe to estimate a third more, while, if the number of young trees planted during the past five years be included, the total number of apple trees in these counties would probably amount to two and one-quarter million trees respectively. The apple crop of 1901 brought these two counties about two and one-half million dollars for green apples and about one-half million dollars for evaporated. The excellent returns stimulated a fresh interest in commercial apple growing, not only in these two counties but the other elevated counties of north, northwestern and central-western Arkansas. The commercial plantings almost exclusively are fall and winter sorts.

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* 12th U. S. Census. Also statistical article, "The Commercial Apple Area," by W. A. Taylor, Practical Fruit Grower, Aug. 20, 1902.

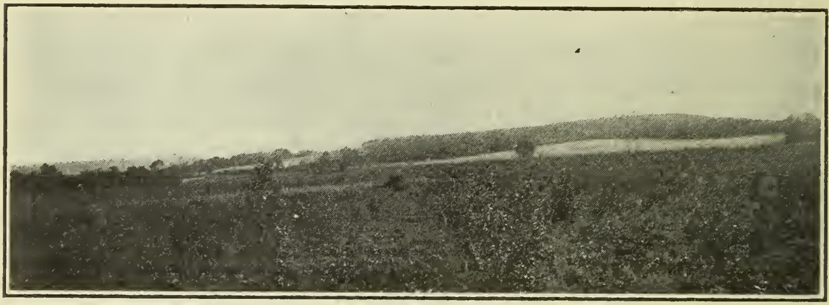

Fig. 2.—A young orchard three years old, Washington County.

The conditions found in Arkansas in the sections mentioned seem especially well suited to the production of winter apples of superior quality. So, although the State as a whole is not thus far as large a producer of apples as several other States, in the matter of quality and color Arkansas is among the very first, while she will rank among the most important apple producing States in quantity as well when existing plantings have arrived at bearing age.

Apple trees in Arkansas naturally bear young and bountifully. The adaptability of the soil and climate for apple growing has been advantageous, but has also been from some points of view a disadvantage. The ease with which profits have been obtained in the past, in spite of careless methods, has encouraged neglect. Neglect, and the prolificacy of the trees, has led to various errors of opinion and practice on the part of many growers.

Commercial apple growing in this State may be said to have begun with the building of the Frisco railroad through Northwest Arkansas some twenty-four years ago. Insects and fungus diseases caused comparatively little trouble at first, but with the increase of the orchard areas fungus and insect enemies have multiplied with the increased facilities afforded. Conditions have changed greatly since the beginning of the commercial apple industry here, and the grower must recognize this fact or he may as well abandon apple growing:

First, The soil in bearing orchards is not as productive as it was when the orchards were first planted;

Second, Insects and fungi are more abundant than at first. Indeed they are so abundant that the grower *must* give more attention to spraying and the various means of control if he would produce marketable apples;

Third, Competition has increased—not merely local competition—but national competition; made possible by the improved system of refrigerator cars;

Fourth, Buyers and markets are more critical. It is not enough to grow apples—they must be good apples;

Fifth, To meet the changed conditions the fruit grower must be more than ever before a specialist. Fruit growing must no longer be a side line in farming, although farming, to a limited extent, may well be a side line of fruit growing. Nor is it sufficient to be a specialist and skilled simply in the production of apples. The development of commercial horticulture requires that this ability be supplemented with business methods.

A few of our growers realize these things and are giving their orchards intelligent care, but the majority still follow neglectful methods. The business has in many cases outgrown the founder. Our orchards present on the whole a neglected appearance. They suggest poorly fed herds of good milk cows still giving milk, but at the expense of their very life blood.

In seasons when there are good apple crops bugs and fungi get a good share of the fruit, but the grower has apples anyhow and seldom realizes his loss. The past season there was a short crop. The bugs and fungi came in for their usual share of the fruit and in consequence the grower, as a rule, had practically nothing left. The crop was light and small the two preceding years. Three light crops in succession, and those shared with bugs and fungi, have been hard on apple enthusiasm. The experience, however, is not wholly a misfortune. It has demonstrated beyond question the failure of the neglectful methods so prevalent among growers and how much we commonly share unresentfully with orchard pests.

While most orchards yielded very poor crops, poor apples and poor returns, the past season, orchards here and there in Arkansas, and elsewhere, where the crop was light and poor, yielded fair crops of fine apples, and because of this and the general scarcity of good apples, brought their owners handsome returns. All the reading, wide-awake orchardists, have heard of or seen such examples the past season. The contrast in returns between the two types of orchards has been almost sensational. Were the difference merely accidental or a matter of soil or locality or "luck," little would the experience profit any one outside of those who were "lucky." As it is, however, this kind of success, or a measure of it, is within the reach of every apple grower and for this reason these scattering successes in an "off year" are of the greatest interest to all. Chance had nothing to do with the difference. The cause of the contrast in results was simply this: The majority of orchards receive only indifferent or no care. The trees are left to struggle with weeds, poor soil, bugs and fungi. Consequently yield only indifferent results. A few orchards receive intelligent care in the way of cultivation, fertilization or spraying, and yield satisfactory returns when the others fail.

It is simply in the main a matter of choice with the grower as to what returns he will have from an apple orchard. There is nothing surprising to the intelligent grower in the outcome of good care applied to the orchard. The surprise is that improvident orchard owners do as well as they do, and that nature is so long-suffering.

The splendid results in orchards receiving intelligent and generous treatment during the past season when almost universally it was considered an "off year," has aroused in growers a fresh and much greater interest than usual in the proper care of bearing orchards. This is indeed a most encouraging outlook. *If the experience of the past season shall result in apple growers abandoning their neglectful methods and substituting for them intelligent and reasonable care of orchards, this season's failure will be worth more to the State than a ten bushel crop on every apple tree, large and small, in Arkansas.*

PECULIARITY OF CONDITIONS AND ERRONEOUS IDEAS RESPECTING ORCHARD MANAGEMENT.

The conditions of soil and climate in the Ozark region of Arkansas are somewhat peculiar and modify practice to some extent. The conditions are such as to favor early bearing and prolificacy. Trees are more dwarf growing than in the North when compared with trees of the same age. In the North trees are sometimes headed at seven or more feet from the ground. Sometimes there the rule was to have the first limb at a height to which an ordinary man could reach comfortably with his hand. This had for its aim convenience in the cultivation of the orchard. The heads there moreover are more open. Here trees are seldom headed above three feet from the ground, often lower. In trees of the same age this results in the lower limbs being close to the ground; indeed fruiting limbs often rest on the ground. The heads of apple trees here are also more compact. The low head (see Figs. 3, 4, 6, 8) interferes somewhat with cultivation but the prevalent winds from the southwest tend to make higher headed trees lean towards the northeast.

Sunscald of trunk and limbs is more frequent here than in the North. High headed and leaning trees are especially liable to sunscald of the trunk.

At the North I do not remember having seen a case of bleeding following the removal of limbs. It is sometimes a very serious thing here in its consequences, though seemingly occurring in trees already diseased in the heart wood and root-system. In such cases the exuding sap from the heart-wood runs down the limb or trunk, keeping it wet. This sap invites micro-organisms which cause it to ferment and kill the bark beneath. "Bleeding" is commonest in the spring following the late winter pruning. I have not observed it in really sound trees, and trees liable to it are best pruned in late summer, or at least after the leaves appear in the spring. Fungus diseases of the bark following pruning or injuries, are more liable to cause damage to apple trees here than in the North.

While rainfall is ample for the year and for the seasons on the whole, the distribution is such as to result frequently in some weeks of dry and bright weather in the latter part of the summer. This is no doubt partly a cause of the high color in our red apples, and partly accounts also for the commonly superior quality of all varieties which succeed here, when compared with the same varieties grown in other parts of the country.

Soil not previously occupied by orchard grows young trees well. They bear early and as a rule prolifically, but this very habit makes more than ordinarily necessary the use of methods looking toward the maintenance of the soil fertility—in other words, good care, and feeding of the trees.

With these conditions before us it is easy to understand how certain erroneous notions have gained a foot-hold, not universally, but among many owners here, and have influenced practice not always advantageously. Some of these wrong ideas have arisen from no peculiarly local conditions, but in ignorant interpretation of experience on the part of the grower who has been too quick to understand, illustrating the aphorism that ignorace sometimes is confident where wisdom enters timidly.

I shall content myself for the present with merely stating the more serious of these erroneous opinions, reserving further discussion of them till later, under their appropriate headings. To proceed, the following erroneous opinions are frequently met with:

"The Ben Davis apple will not bear pruning." The fear of pruning has often extended to other varieties.

"Heading in" apple trees is certain to result in "dying back."

Some who prune apples invariably leave stubs of greater or less length as if drying and dying of the wound being certain, the longer the stub (within limits) the longer deferred is the death of the limb or tree.

"Orchards are short-lived—lasting only about fifteen years." It is not uncommon for growers to practically abandon orchards which have arrived at that age on the ground that they have served their usefulness.

"Orchards being short-lived" it is a common practice to plant the trees closely so as to compensate by larger yields per acre for the short life of the orchard. The trees are usually allowed to bear as they will. Over-bearing, as a rule, is not a cause of anxiety but of satisfaction. "A short-lived orchard must bear heavily if it is to be as profitable as it should."

Cultivation is neglected to a greater extent than practiced. There are writers who condemn it and they, it would seem, have a large following. Others doubtless imagine they are following the teachings of nature. A few have tried cultivation and think it harmful. The balance have come to their ways because the cultivation of other crops seems more important. The orchard will do without it—other crops will not.

Few spray. They question spraying—not their own method of doing it. Some have tried it and found it a failure. The majority neglect it simply because they do not understand how present conditions make apple growing different from apple growing in the days of our forefathers, when spraying was unheard of and yet ''we always had apples.''

It is time orchard growers were abandoning such notions—they have no foundation in fact, and constitute a ruinous policy. They have been thoroughly tried by our growers and have proved to be sources of mischief and loss. The grower is not to be blamed for adopting those methods in his business which with least cost yield the greatest returns. The ideas mentioned are along the line of minimum expense, but also in the direction of minimum returns. The main trouble is, our fruit growers have not been putting enough study into the business of growing apples. Few indeed understand their orchards and soils like the druggist does his bottles and the physician his patients; and how few drive their work with the devotion, intelligence, judgment and energy of the successful merchant.

A moment's thought on the part of one who owns an orchard shows the absurdity of such advice as the following, yet how many have allowed themselves to be fooled by it year after year. Too often we take advice from a man without a question as to his special qualifications and right to give it. The advice is from a book, dated 1902, in which the author, not an orchardist, but a fruit merchant, gives instruction to fruit growers and shippers in the South. Speaking of apples he says:

''Being entirely hardy, producing a crop every year, and thriving with very little care, they (apples) can be grown by the most inexperienced.''

This is a perfect dream—how attractive—a cloudless summer sky; but there is a thunderbolt from the clear sky in a previous paragraph in the same book which reads:

''Before proceeding farther it is proper to state that the demand for cheap or inferior products, either fruits or vegetables, has fallen off to a wonderful extent the past few years. Of late years there has been practically no demand for anything but first-class goods. In former years cheap goods were not so neglected. The peddlers and cheap class that formerly bought second-class products now look for better stock at better prices. Take strawberries, tomatoes, cucumbers, etc., which come in steadily during the winter and early spring, only, choice can be sold. Anything the least bit off, either in quality or condition, is not wanted at any price, and it is very difficult to place such even at half price or less. Shippers and growers should govern themselves accordingly. There is money only in the best stock. These remarks apply to all markets.’’

THE REJUVENATION OF AN OLD ORCHARD.

THE ORCHARD AND THE RESULTS.

Upland orchard, chert land, poor soil, corned to death. Corned since before the war, and for seven or eight years after the orchard was planted. Farm 158 acres, woodland 98 acres, cultivated land 60 acres, orchard 40 acres, twenty-seven (actual area) occupied with the old bearing trees, 2,000 of them. Planted 25x25 feet, sixteen years old, part of the trees thirteen. Two crops—Full crop 1901, which sold in orchard for $2,600. No crop since till the past season, 1905.

This was an ‘‘off year’’ practically in orchards almost everywhere. Only about twenty per cent of a crop in Arkansas, and seventy-five per cent of that as a rule went scabby and buggy. Poor stuff. One Arkansas grower says apples this year generally were the ‘‘measliest’’ lot of stuff he ever saw. Our run-down orchard however ‘‘hit.’’ Apple men said, as a whole they were the finest lot of apples grown in the State the past year. The older trees did most of the bearing and gave the finest apples. This block received the best spraying and most of the pruning and fertilizer. It yielded at the rate of $120 per acre. The apples were placed in cold storage and were held till February, keeping fine and fresh. See Figs. 3, 4, 6, 8.

Value 534 barrels No. 1 to fancy apples at current prices	$2,077.50
No. 2 culls and vinegar	240.00
Total (orchard)	$2,317.50
Expense—Spraying, fertilizing, pruning, cultivation, barrels, boxes and storage	$883.30
Proceeds orchard ‘‘off year’’ (one year fair care)	$1,434.20
Value other farm products	441.20
Net proceeds orchard and farm	$1,875.40

Interest was not deducted in above summary.

A neglected orchard of thirty acres of trees in the same locality, nearly as large, similarly situated as to soil and elevation, yielded at gathering time, the owner informed me, seventy barrels of poor No. 2 apples, which brought $1.50 per barrel. Another orchard under the same conditions, and of about the same extent, had about twenty per cent of a crop but not a barrel of apples above the grade of a poor No. 2, and nearly all of the cull grade. The two last mentioned orchards represent the neglectful method so frequently seen.

The first mentioned orchard shows the results of a single season's fair treatment of an old and run down orchard. These good results were to some degree immediate, but there is the additional satisfaction that the work done will benefit the orchard and the crop more the second year and will continue to show for several seasons. The care bestowed cost something more than would be the case in an orchard receiving some care every year. But as it was, the cost of the work gave practically a three-fold return the same year, while the receipts from the apple crop were about eight dollars to one as compared with many orchards not given such care.

Here was a test of spraying and other care in an orchard on a commercial scale. The neglected condition of the orchard and of neighboring orchards, the worn character of the soil and the seasonable conditions as to crop and weather, made the test an unusually severe one. As all know insect damage is more concentrated and severe in seasons of a light crop. Moreover, neglected orchards near by always tend to diminish the benefits of spraying in an orchard receiving such care. One hardly expects to have the fullest benefits of spraying and care in an orchard never sprayed before and debilitated by long continued mistreatment otherwise. In addition, frequent rains during the spraying season proved very annoying. They rendered spraying almost wholly ineffective in some orchards the past season where ordinarily spraying had proved very efficient and profitable. The work was done on limited means which made it necessary to make every dollar tell.

Had Arkansas orchardists generally given such care to their orchards with equally good results, it seems safe to say that this year's crop, although light, would have brought close to a million dollars more to growers here than was actually realized.

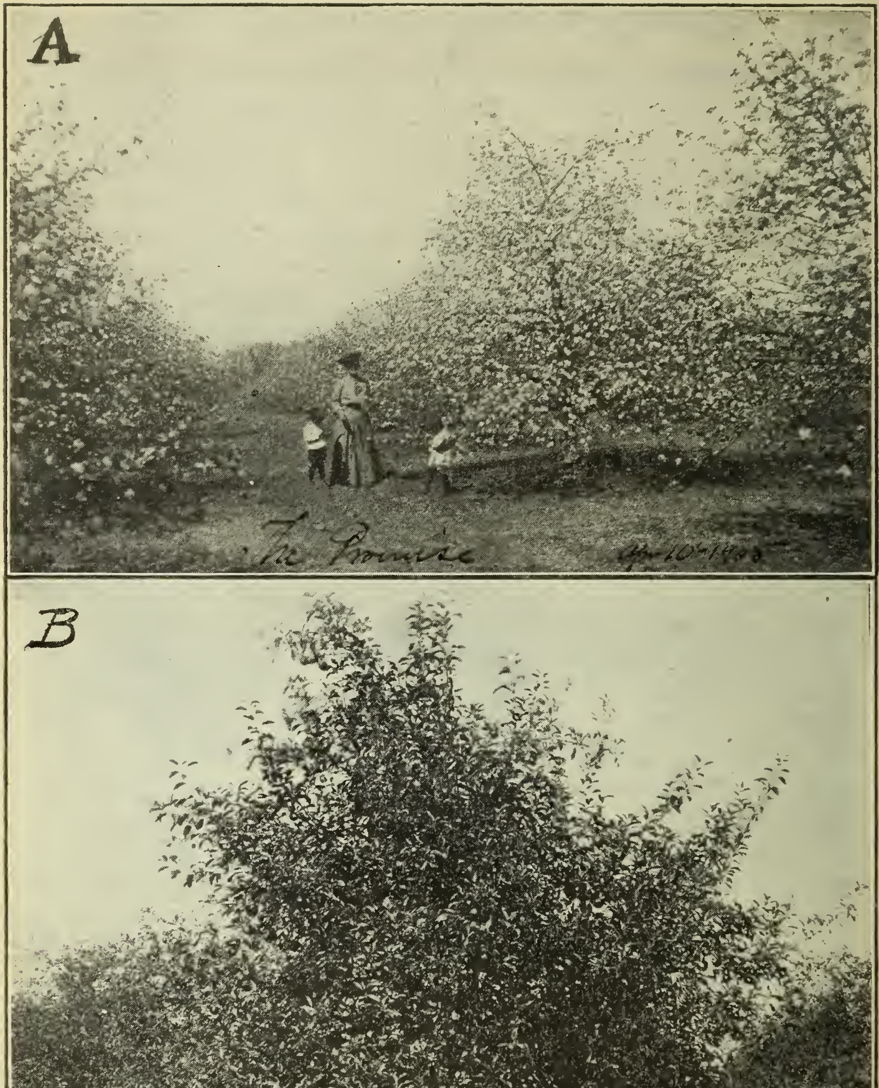

Fig. 3.—Results. "Off year." The same tree April 10 and September 15, 1905, sprayed and "looked after." Apples 90 per cent sound. Tree bore five bushels.

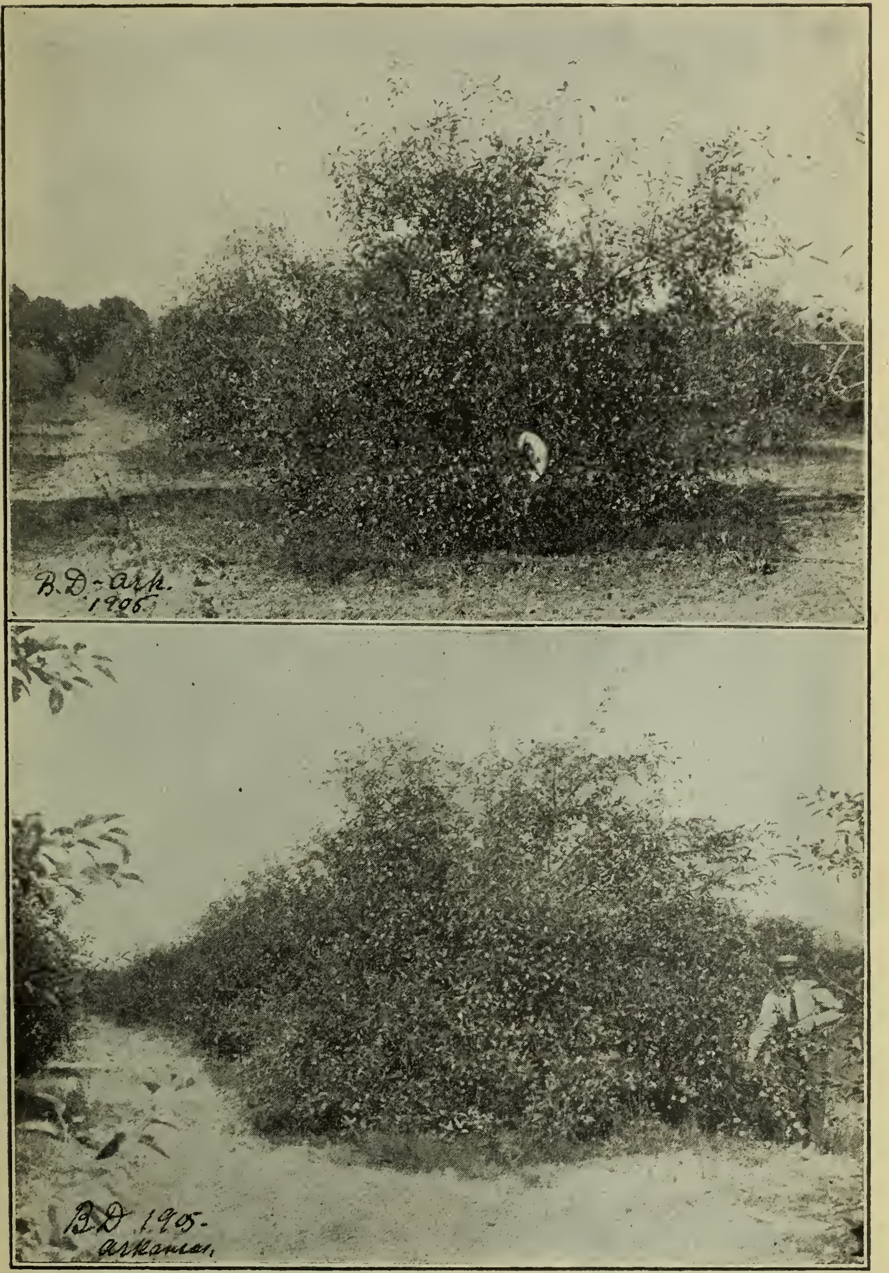

Fig. 4.—Results. More "off year." Ben Davis, 16-year trees, sprayed and "looked after." Three to seven bushels per tree.

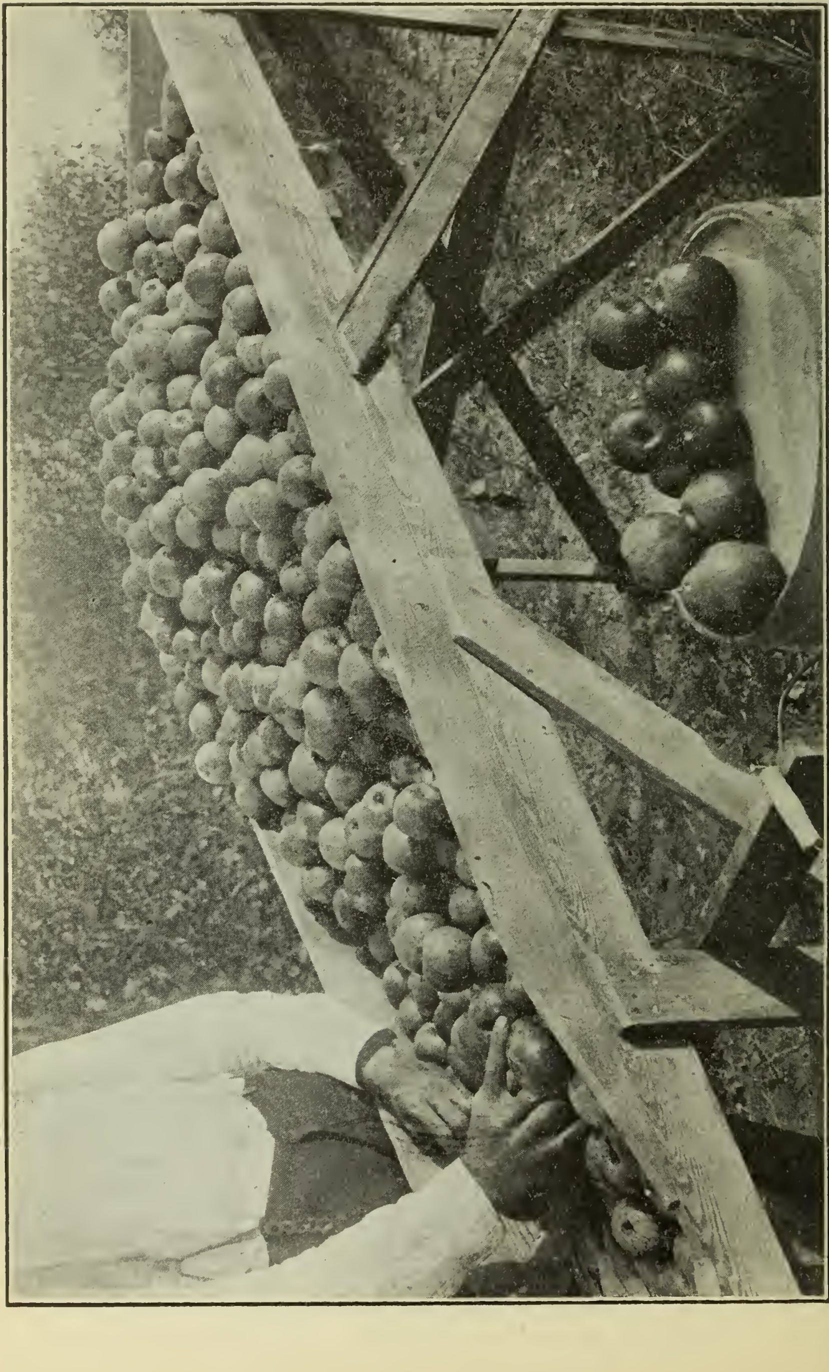

Fig. 5.—Some more "off year" in Arkansas. Sprayed Ben Davis as gathered and passing over the cull table. These apples were 93 1-3 per cent sound. In unsprayed orchards what few apples there were were 75 per cent culls as a rule.

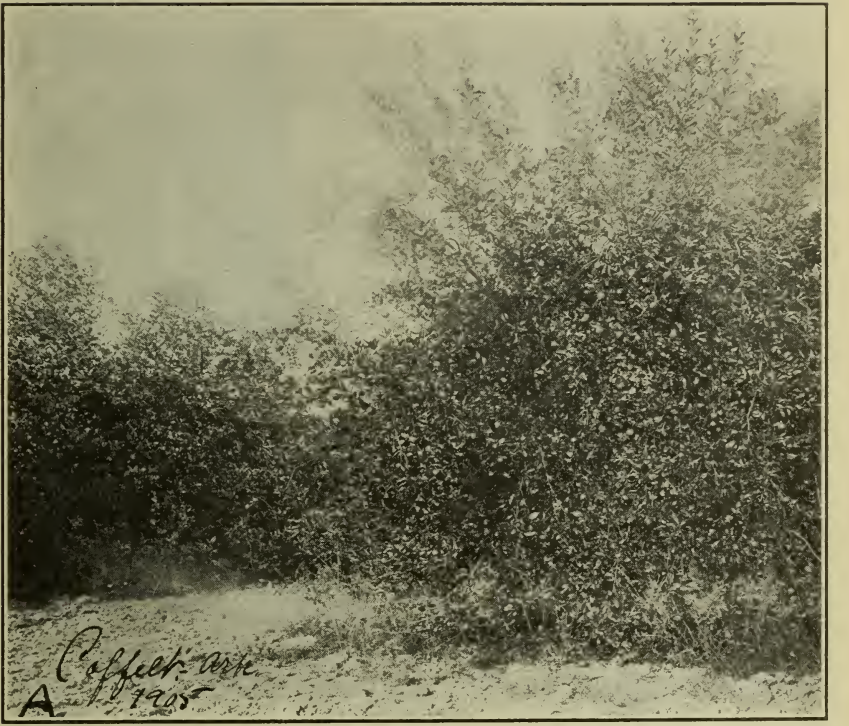

Fig. 6.—Coffelts in the old orchard, September, 1905. Results of spraying and other care.

WHAT WAS DONE IN THE OLD ORCHARD.

The writer began directing this work in this orchard in August, 1904. A man was regularly employed, and two about half the time. Additional hands were employed from time to time as needed. Twenty-two men and four teams were employed during the apple harvest. The regular work of the year has been done by inexperienced farm labor, working under direction. The attention given by the writer has been such as is usually possible with men engaged in business or professional work in town, with only limited time for the enjoyment of farm or orchard interest.

CULTIVATION AND COVER CROPS. CONDITION AND SOIL.

Although late in the season, shallow plowing of the orchard was at once begun on taking charge. This was for the purpose of sowing a winter cover crop of cow-horn turnips and crimson clover. The conditions moreover, were dry, and conservation of moisture was also an object. It seemed desirable to retain the scant foliage of the trees as long as possible. The soil being hard necessitated the work of a two-horse plow, although the plows were not allowed to run deeper than three or four inches. Even then a few moderately large roots were broken—the roots on the whole being rather near the surface. (We should cultivate later here than in the North for reasons explained later. See pp. 179, 180.)

Crimson clover was sown at the rate of ten pounds per acre (about half the ordinary allowance), and one and one-half pounds of cow-horn turnips. Being sown late and during dry conditions, although there was a fair stand the crops made only small plants during the fall. The sowing in the east part of the orchard was not done till so late that although the seed germinated the crop was wholly killed out during the winter. In the old orchard at the west end, where the sowing was done in September, the crimson clover though small, went through the winter and late in the spring made a light crop of herbage, which was turned under. Spring rains interfered with cultivation and the intended cultivation was abandoned on this account. It was begun in July, however, and a heavy growth of weeds and grass was turned under. By the time plowing was completed the past summer, the sowing of winter rye and crimson clover was begun. The crimson clover was sown upon the poor places. The balance of the orchard was sown to rye to carry the soil nitrates over the winter, and afford the benefit of a winter cover and for the humus it furnishes when plowed under.

The run-down condition of this land is in a large measure due to the deficiency of humus, although it was also very low in available plant foods from long cropping without rotation, or the use of manures or fertilizers. The growing of sorghum hay on a vacant spot in the orchard was undertaken during the past summer. It was sown moderately thickly. At eleven weeks from sowing the average height of the sorghum was two to two and a half feet high. In other places on the same land, along the fence where the soil was not so exhausted, sorghum in the same length of time grew up thickly four to four and a half feet high; was then cut and furnished a second cutting as tall as the single cutting from the patch above first mentioned. This patch had a light growth of weeds turned under when being prepared for the sorghum. The spring-tooth harrow was used afterwards. It clogged and dragged out some of the weeds. These were dropped at the sides of the patch in heaps, mingled with soil. The sorghum which fell on these plots grew strong, seven and eight feet high, in the time the rest of the patch was feebly attaining a height of two and a half feet. Fig. 7.

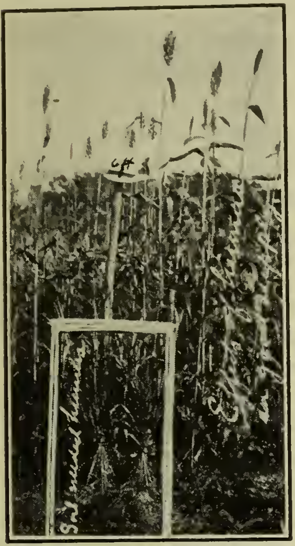

Fig. 7—Sorghum on worn out soil, deficient in humus; and on same soil well supplied with humus. These bunches grew only about 20 feet apart.

The chemist, Mr. J. H. Norton, analyzed samples of the soil and subsoil, taken at several points in the orchard. Such an analysis is of course of little value in indicating the soil's actual productiveness. It does not show the availability of substances in the soil needed by plants, or the power of plants to utilize these substances. A soil may be rich in food elements and yet wholly unproductive owing to deficiency of humus, bad physical condition, etc. Smaller amounts of the plant foods available are worth more in farming lands than larger amounts locked up. Lands are sometimes "fertilizer sick;" not so much because of the excessive use of fertilizers, but because of the neglected physical condition and deficiency of humus essential to the availability of the soil's fertility, or the excessive use of a single kind of a fertilizer. It is time enough as a rule for the grower to ask about his lands' need of commercial plant foods after he has done all he can in the way of improving his soil's physical properties by means of thorough tillage, the careful use of his farm manures, and the addition of humus through the intelligent use of green manure.

The test made with the sorghum seems to show that in the case of this run-down orchard land the principal deficiency is humus. The chemist's analysis was made for the purpose of determining whether there was any great deficiency or excess of any of the principal soil constituents.

The results of the analysis showed considerably less than half of the humus present in even an average southern soil, which, itself, nearly always contains a low per cent. Nitrogen showed only a little more than half the amount found in an average southern soil. Potash was very low, even in the soil which had received an application of wood ashes at the rate of three tons per acre, being less than one-tenth the amount for the average southern soil, but showed .010 per cent more than in the soil not receiving the ashes. Phosphoric acid was in excess, being more than double the amount contained in the average southern soil. (See p. 189.*) Lime was slightly below normal in the oldest part of the orchard but in other parts not so long under cultivation was about double the average amount. Sulphuric acid was in marked excess of the amount found in average soil, being fifteen to nineteen times as great in the surface soil and still greater in the sub-soil. Iron was 2.42 and 2.43 per cent, as compared with 2.00 in average southern soils. Magnesium was less than half, to slightly more than half the usual amount.

The insoluble residue (inert matter) of the soil was from 91.93 to 93.81 per cent in this orchard soil, as compared with 87.50 per cent in the average southern soil.

A comparison was made of the surface soil and the sub-soil. In newer ground humus was greatest in the surface soil. In the oldest land it was greater in the sub-soil. The same with regard to nitrogen. Potash was low, about equal in both surface and sub-soil, though greatest in the surface soil (about one-third more) in the orchard receiving the application of ashes the preceding fall. Phosphoric acid was from one-third to one-fourth more in amount in the sub-soil of both newer and old land. There was in amount about one-fourth more phosphoric acid in the sub-soil of the old orchard than in the surface, and one-third more than in the sub-soil of new land never in orchard but occupied by forest trees six years previously. Lime was greatest in the surface of new soil. In the old orchard it was more abundant in the sub-soil.

These data reveal the state of affairs in an old worn out piece of land brought about by fifty-four years of, not farming, but soil-robbing—of taking off crops without ever putting anything back except possibly doses of superphosphates as was a frequent practice some years ago among those who sometimes tried to correct the damage they were doing to their soil. Such farmers often supposed ''fertilizer is fertilizer'' and quite recently I have found farmers using fertilizers without the least knowledge of what they contained in the way of plant food. One man who needed potash principally for his land and crop, was ''laying'' on the phosphate alone.

FERTILIZERS.

Forty-nine loads of stable manure were used in the winter of 1904. This was applied to the re-sets and weak trees and on the high poor portion of a part occupied by Coffelts. Each re-set received four shovelfuls. The manure was scattered somewhat, about a foot from the small trees, and beyond the branches in the case of the larger ones. This manure was in part hauled from town, a distance of about six and a half miles. The wagon hauled a load of wood in, and hauled out a load of manure. The wagon seldom returns from town empty. This made the manure cost $1.10 per two-horse load. The manure had been purchased by contract and stored on a vacant lot on the edge of town convenient for the wagon on its way out. In addition seven head of cattle were kept on pasture and placed in the barn lot each night. Their manure was gathered and saved, and in addition the manure from the team. From this source, and what was gathered up about the barn and barn lot at the out-start, were obtained some thirty-five loads during the year. Twenty-eight loads of this were used again about weak trees in the older part of the orchard, at the rate of ten to twelve shovelfuls per tree, scattered beyond the ends of the limbs of the trees. A portion of it was used on re-sets in poor ground in another part of the orchard which had not received manure previously. Altogether, during the development of last year's crop, seventy-seven loads of manure were applied to the orchard in the manner described.

In addition to the above seven and a half tons of commercial fertilizer were used. 1,250 pounds of this was a nitrogenous fertilizer. This was applied to re-sets at the rate of a pound to the tree on trees which had not received stable manure. The balance, consisting of potash and phosphate, with a touch of nitrogen, was applied to the bearing trees at the rate of two to three pounds to the tree, according to size, while the block of oldest trees was given four pounds to the tree. The Shockleys received also four pounds. This was at the rate of about 225 to 300 pounds per acre, a very light application under the circumstances. This fertilizer was applied in May. Earlier would have been better, but circumstances prevented its being done earlier.

The grass and weeds covering the ground—the soil being kept too wet to plow by frequent rains—promptly showed the effects of the fertilizer (nitrogen mainly) and the ordinarily feeble growth pushed up rapidly into what neighbors, who have long lived near, said was the heaviest growth of weeds they had ever seen on the land. Rag weeds, that in former years had grown scantily and feebly, last year attained a height of three or four feet. This was in the main due to the fertilizer but partly to the cultivation the preceding fall. There was no such growth of weeds in neighboring unfertilized orchards.

The application of ashes previously mentioned had a marked effect upon the texture of the soil throughout the block of older trees. This land had previously been heavy and ''lifeless,'' as we sometimes speak of such a condition. It baked and became hard. The following spring when the block was plowed the workmen spoke of the marked change in the soil. It now plowed mellow and velvety. With the addition of the crimson clover, the weeds plowed under the past fall, the texture has been still further improved. The effect was partly mechanical but no doubt principally due to the beneficial (flocculation) effect upon this heavy clayey soil of the large percentage of lime contained in the ashes.

The results of observations made the past summer upon plants and soils not supplied with phosphoric acid, but with the other substances—humus, nitrate of soda, stable manures, as well as the results of the chemical analysis of the soil, showed that the addition of phosphoric acid in the fertilizer was unnecessary, and the indications are that the defects of this land can largely be corrected through the use of potash fertilizer, lime, and the growing of legumes, which will supply nitrogen and humus—and by supplementing the summer crops of cow-peas, with winter rye or other plants to conserve the nitrogen obtained during the summer. Later on, after the free use of potash and leguminous crops for a few years, and some crops of fruit, the addition of phosphoric acid in the fertilizer may not be out of place.

It is well for each grower to observe closely the growth and yields of his crops, study his soil and experiment with the several fertilizer ingredients on a few trees, or separate blocks. Then he can buy the particular form of plant food he most requires, or in buying a ready-mixed fertilizer of known composition he can correct it by adding to the amount of this or that ingredient according to the needs of his soil and crop.

DRAINAGE.

There is a wet-weather stream-bed through the eastern part of the orchard. Weeds and sprouts had been allowed to clog the flow of the water and caused the ground to be very wet in the low ground. With a two-horse plow a broad ditch was opened from about the center of the orchard to the east end, and an outlet provided for the water. The beneficial effect of this surface drainage has been very marked. It is now possible to plow this ground some days sooner after rains than was formerly the case, and apple trees in this part of the orchard have been benefitted.

PRUNING.

All the trees were remarkably small for their age. There are few trees in the orchard from which the apples could not be gathered with a ten-foot step ladder—while a step ladder would be ample for most of them. (See Fig. 8.) Top limbs on some of the trees were feeble. There were dying limbs to be removed—almost all the trees were bushy, and much too thick. Pruning was begun in August, 1904. Much of the foliage had been shed by this time. The trees needed immediate feeding, but an immediate application of manures or fertilizers was not possible. Pruning, however, on such trees, is manure. (Fig. 9.) So it was decided to give an immediate application of this sort of fertilizer to benefit the crop of the succeeding year, should there

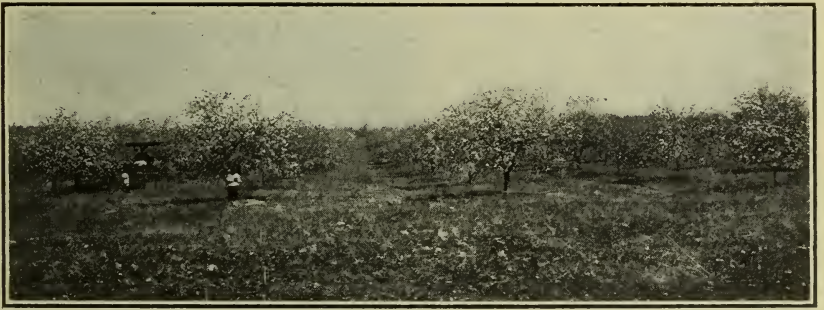

Fig. 8.—The block of 16-year-old Ben Davis on old worn land, April 10, 1905. Small for their age. Humus of soil deficient; land needs manure, and leguminous cover crops.

be one. The work was commenced at once and continued with interruptions till the following March.

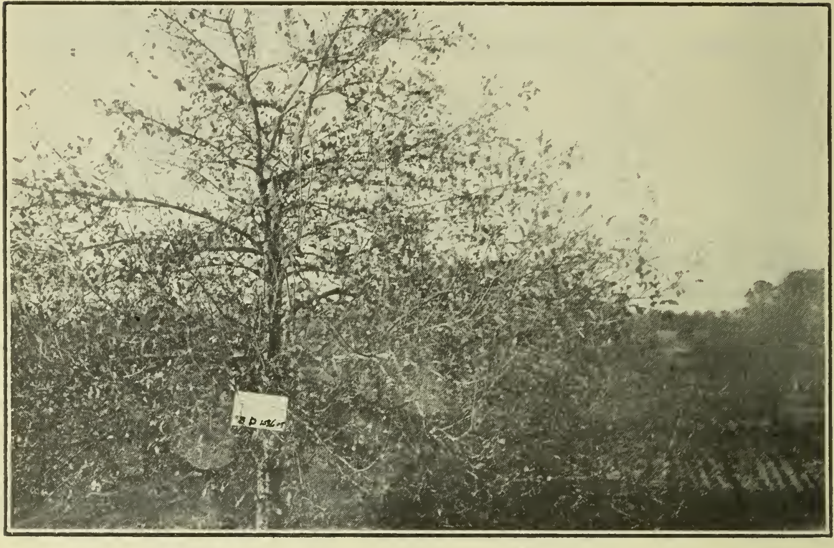

Fig. 9.—A Ben Davis tree in the old orchard, Oct. 26, 1905, showing growth following pruning and other treatment given. Previously, almost at a stand still.

The early fall pruning was only moderate as heavy pruning would have tended to cause a swelling of the buds, or even a late growth. The removal of large branches was avoided where possible, yet where the limb was weak or circumstances made it desirable to remove it the limb was promptly taken out. When the top branches were weak or the head thin, or the tree growing lop-sided, topping was done. Care was observed always to make the cut in this case just above a good side branch—a very important matter, as this avoids the danger of the dying back, frequently deemed an inevitable consequence of "topping in" trees. Where there was much twiginess considerable thinning out was done. On the south and southwest side of trees, however, less thinning was done as the shade is desirable, and so much thinning there is not necessary.

The removal of side limbs was made by a sharp saw or pruning shears close to and parallel with the main branch. The Rhodes Double Cut pruning shears, both of the large and smaller size, were found to be a great improvement over the old style. They cut like a knife—with no bruising. The larger size readily severs limbs one inch in diameter. Saws were found to cut apple wood better when filed almost as straight across as a rip-saw, and having only a "shallow set.'' The ''pole pruner'' was used in ''heading in'' high limbs as much as 7/8 inch in diameter. Bruising and rough wounds were avoided. Wounds were painted at once with pure white lead and linseed oil paint—no turpentine. During winter, wounds were given a second coat, as after drying, wounds often ''check.'' A second coat fills these cracks and keeps out water. Trimmings made in August, September and October affording a breeding place for the fruit tree bark-beetle, *Scolytus rugulosus,* and the bark of trimmings became undermined with the burrows of this little sinner. Great care was used to have all trimmings piled and burned during early February in order to destroy these pests before they had escaped. Each tree was treated on its merits. Weak trees were severely pruned to throw them into growth—vigorous trees were ''touched'' more lightly. No ''bleeding'' resulted in any case, which is often to be feared in trees with diseased heart-wood and root systems. Late summer is a favorable time for cutting back such trees.

TREE SURGERY.

In some instances trees were almost literally placed upon the ''operating table.'' (Fig. 10.) In a few instances the dying condition necessitated the removal of half or more of the top —again the removal of a dying limb on the south side of a tree in previous years had resulted in ''sun scald,'' and injury by the ''flat-head borer.'' In some such cases a diseased root on that side of the tree from some cause or other has been the source of the dying limb. The fermenting sap from the diseased root has been carried up and caused a feeble or diseased condition of the limb above, and of the young wood and cambium on the same side of the trunk. In such cases the further rise of sour sap was stopped by cutting in through the dead wood at the foot of the trunk,

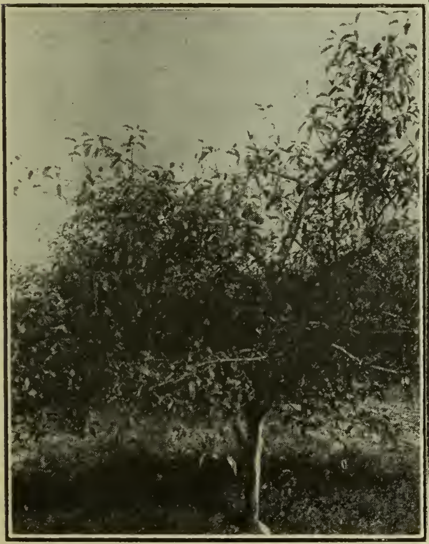

Fig. 10.—A tree with wound dressed and top cut back, some months after treatment. Heavier cutting back would have been desirable. Doing nicely, however.

to live wood. The dead wood was hewn away above also. This resulted in some cases in the removal of more than half the trunk. The top was cut back from half to three-fourths, in proportion to the injury and weakness of the tree. The wounds were then well painted. They were given a second coat after some weeks.

Some of these trees were taken in hand simply as a matter of experiment. Others, however, were too far gone to make such work worth while. But it takes too long to grow a bearing apple tree to cut such a tree down if it can be saved at an expense of five to fifteen cents.

In other cases, or where the tree was not in too bad condition, such work was considered well worth while. The topping back, an application of nitrogenous manure and subsequent cultivation, are important parts of the treatment.

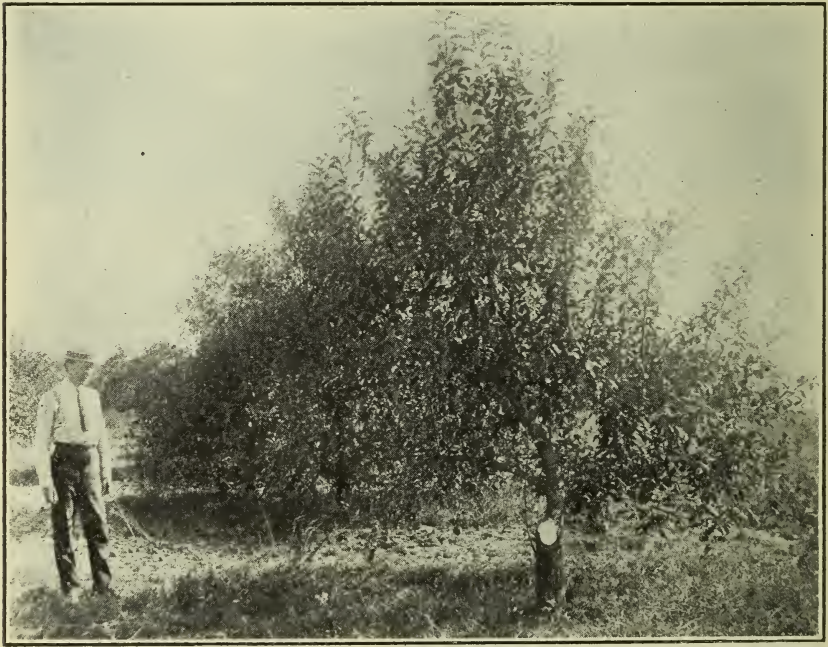

Fig. 11.—Old apple tree with large part of head removed, to save the tree. Wound well painted. First year after treatment. Tree good for ten years more at least.

Several of these trees treated, bore one to three bushels of good fruit the past year and have taken on a new lease of life. They have made a vigorous growth of shoots in the tops, and the large wounds show splendid progress in the formation of new tissue along the margins of the wounds. Likewise, trees of which a large portion of the top was cut out have made a vigorous growth of shoots, and in three to five years promise to have good new heads. In Fig. 11 where one side of the top of the tree was removed and a very large wound made and painted a couple of water sprouts have appeared just below the wound. These are being preserved and stimulated with the view of replacing the part of the top removed and restoring the shape of the tree. Topping back the remaining half of the tree, from time to time, manure and cultivation, will be made use of as necessary parts of the process.

In other trees, in a similar way, gaps, or thin places in the head of the tree are being filled out. A well located water sprout is in this way often turned to good account.

The results of the regular pruning given have been most beneficial. Many of the trees pruned and ''headed back'' were the much feared Ben Davis, but in no case in this variety or any of the others, has dying back of bark or wood resulted. On the other hand, wounds have invariably made good progress in the way of healing over. Many of the wounds are one-quarter to one-third of the way healed over in the one year since they were made.

There were here and there through the block of Ben Davis rough barked, hide-bound, stunted trees, of very diminutive stature for their age—being not larger at sixteen years than fair average trees should be at four or five. These were pruned back severely, and the bark slit with the point of the knife in several places along the main branches and on the trunk. This, in connection with cultivation and fertilizers applied subsequently, has resulted in a fine growth of twigs, and an addition to the height of the tops of from eighteen inches to two and a half feet in the single season following. The slits in the trunks and branches are gaping from ⅛ to ¼ inch and bridged across with new tissue. These trees bid fair to abandon their dwarf habit and after three or four years to become fit companions for their more prosperous mates.

The pruning has been of great benefit throughout the orchard. On all the pruned trees there was a terminal growth of 12 to 28 inches as compared with a feeble growth of 6 or 8 inches under previous conditions. As a result of the pruning, in connection with the cultivation, spraying and fertilizers used, the apples the past season on this block of sixteen-year-old Ben Davis were much above the average size. Hundreds of specimens measured fifteen and sixteen inches in circumference, while the average size was such that only 110-120 apples were required to fill a bushel, or 330 to 360 to the barrel.

SPRAYING.

The fungus diseases and insects of the apple (not tree) very prevalent and serious in Arkansas orchards are apple-scab, bitter-rot, rust, fly-speck fungus, sooty blotch, the apple-worm or coddling moth, the plum curculio, a narrow winged katydid, and apple maggot.

Scab the past season was very abundant, affecting from fifty to ninety per cent of the fruit in unsprayed orchards. Late in the season scab infested fruit cracked open badly. The conditions were not favorable to bitter-rot late in the season, being too dry. There was slight injury from it however, in the form of black specked apples, developing also to some extent after barreling. Traces of it were very prevalent.

The spring conditions were favorable to apple or cedar rust and more of it was seen than the previous year, though less than I should have expected to find. Fly specks fungus is not uncommon in unsprayed orchards. The apple-worm, or coddling-moth was very abundant. Without spraying it has frequently been found to affect from twenty-five to seventy-five per cent of the fruit. In some instances, as high as eighty-four per cent of the apples were wormy.

The curculio, which causes the "sting" often complained of by growers, was on hand and did much damage. The green, narrow-winged katydid (*Scudderia texensis*) was plentiful and did considerable damage by eating large holes in the sides of apples. Commonly the finest specimens seem to be the ones selected for the fine taste of this depredator. (See Fig. 12, C for character of injury and photograph of specimen.)

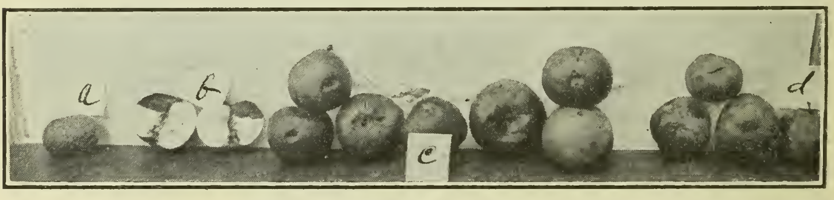

Fig. 12.—1—Fly speck fungus; 2—Codling moth injury, followed by decay; 3—Holes eaten in apples by the narrow-winged Katydid (Scudderia Texensis); 4—Scab injury to fruit.

This injury was done during August and September. For some time I was in doubt as to what caused the injury. Those who were asked about it attributed it to wasps and yellow-jackets, the latter of which had nests under many apple trees among weeds and grass. The eaten places were commonly finished and empty when found. Later, however, I found in several instances the katydid at work on a freshly gnawed cavity. The one shown in the photograph was thus captured in the act. This insect's depredations injure three to five per cent on many trees. The injury is principally a disfiguring of the fruit, as the eaten surface dries, and decay seldom occurs from the injury even in storage.

Spraying of the orchard with liquid cost three and three-fourth cents a tree. The efficiency varied in different parts of the orchard owing to several factors. Frequent rains and continued rains interfered much. The best results were found in that part of the orchard where each time the spraying was begun. It seems the men did the most thorough spraying while fresh. The spraying was also more timely. Here the proportion of sound apples was sixty bushels to four bushels of culls, which equals 93 1/3 per cent. In other parts of the orchard sprayed the percentage of sound apples dropped back to 89 and 84 per cent respectively. On the whole, spraying gave an average of about 90 per cent of sound apples. (Figs. 3, 4, 5, 13.)

We did the spraying with a barrel pump mounted on a 150 gallon half round tank. The rig was too small for the number of trees and it was impossible to get over the entire twenty-seven acres as promptly as was necessary for the best results. The weather interfered, also. Part of the orchard was therefore only imperfectly sprayed and the percentage of No. 2 apples and culls in this part of the orchard ranged at 30 per cent. An ordinary barrel pump is sufficient for only about ten acres if the spraying is properly done. Most of our orchards should have a power rig. While expensive at the start it is cheaper by far in the end in a large orchard. The increased efficiency, not to mention the saving of time at a season when time is valuable, will in a 30-acre orchard of bearing trees pay for a $200 rig three to five times over in a single crop year.

A row of trees were dust sprayed through the season. The Maxwell formula was used—six sprayings. The foliage and fruit of these trees was not as perfect as with the liquid. There was some benefit. It gave better results against codlin moth than against scab. It was very efficient for tent-caterpillars, and rapid. The apples from one of the dust sprayed trees were sorted out, with the results shown in Fig. 13, B. (For suggestions upon spraying, see pp. 197-210.)

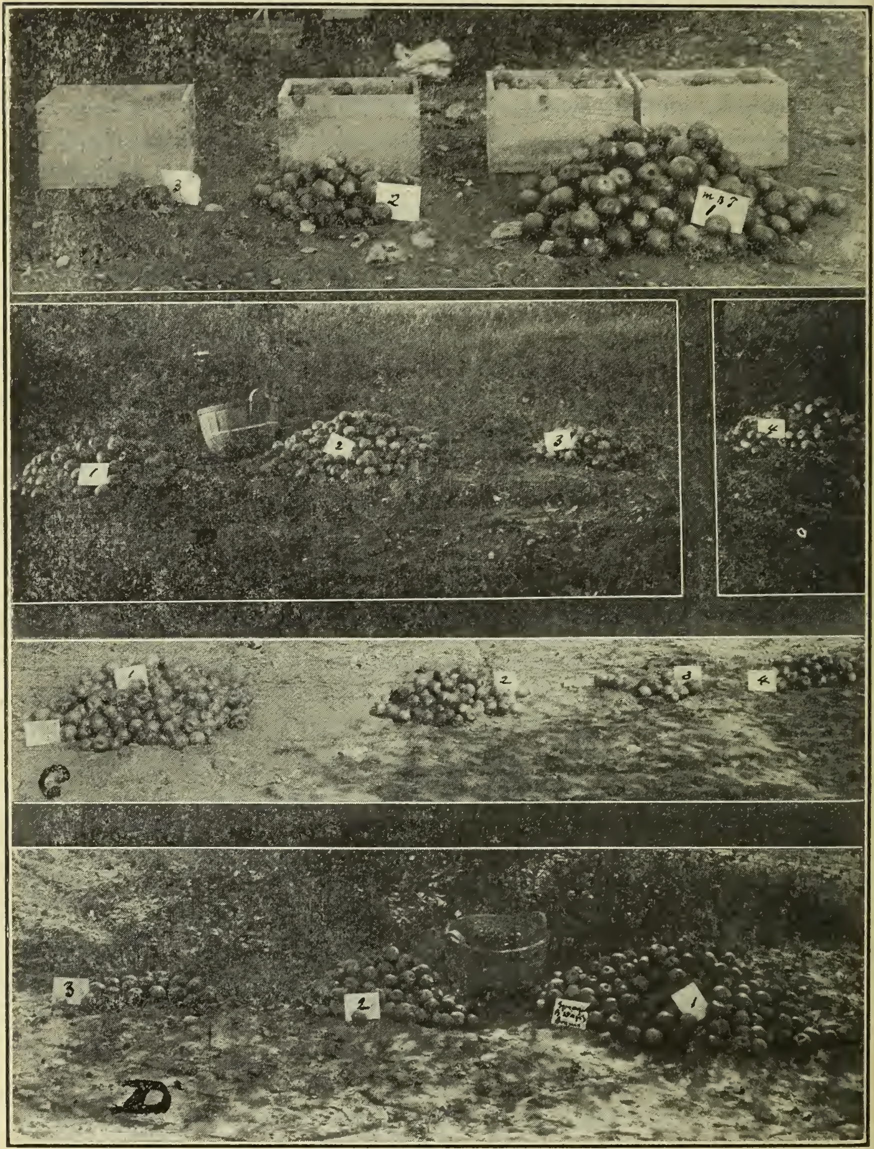

Fig. 13.—Average results spraying, 1905; A—Mammoth Black Twig; C. D.—Ben Davis, sprayed, piles 3 and 4 culls; B—Dust sprayed Ben Davis, piles 3 and 4 culls.

SUGGESTIONS UPON THE CARE OF BEARING ORCHARDS.*

The results just described answer in a practical manner and on a commercial scale the erroneous opinions held by a number of orchard owners and mentioned on a previous page. These matters, however, perhaps, need some discussion.

ARE APPLE ORCHARDS SHORT LIVED?

The notion that apple orchards are short lived is the offspring of neglect. There is no inherent weakness in an apple tree which limits its life to a few years. There are various outside agencies, however, which may have this effect, the chief of which is man himself.

Were man content with one living tree in ten thousand, with apples so sour that they would "take the edge off a knife" with apples the size of crabs, he might leave the problem of orchard growing to nature, as many men seem inclined to do (on the ground that all this cultivation, pruning, fertilizing and spraying is unnatural.) But nature laughs at such philosophy and says, "in the sweat of his brow shall man eat bread," and again, "go to the ant thou sluggard."

The ant is distinguished among insects not merely for wellnigh ceaseless industry, but for the intelligence that characterizes all her labors. Many of us are industrious enough, but mere unceasing activity and great hopes amount to little. It is the intelligence put into our efforts—the understanding, that gives the stroke its potency and makes it a means to an end. Nature is ultimately intolerant of neglect, let the excuse be what it may, and yet she visits with disaster the childish efforts of the man who toils without understanding. It is "in the sweat of the brow" the law reads.

"Being entirely hardy, producing a crop every year, and thriving with very little care" and the assumption that apples "can be grown by the most inexperienced" does not harmonize with the experience of Arkansas orchardists; and we know, because that is the very philosophy many of us have been practicing all these years. Here is the parent of the idea that apple orchards are short lived. Experience has not led us astray. It has taught us a truth. Arkansas apple orchards are short lived—under such a policy. They die off after a few years just like apple trees do in the rest of the world when man throws upon them not only the bearing of apples but the management of the orchard. Nature is very kind for a while to two classes of individuals: drunk men and infants, but she draws the line at suckling full-grown men.

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* Bulletin 71, Ark. Agr. Expt. Station, discusses a number of matters of importance to Arkansas orchardists.

If orchards are short lived under neglect, simply working themselves to death, under kind and intelligent treatment their lease of life and profitableness may be extended to a good ripe age and long enough to meet the reasonable expectations of any man. Instead of failing at fifteen years orchards should be flourishing and paying handsomely at thirty years and longer. It is with the owner, and not the tree. It is a matter of intelligent care in the way of feeding the tree, pruning and wise cultivation.

THE PRUNING IDEA.

Experiments in pruning, at the station, during the past four years, on various varieties, including Ben Davis, and its descendants, at various seasons of the year, as well as the work in the large orchard last year, show that whether pruning is injurious depends on the manner in which it is done, rather than upon the season or size of the limb.

The work was undertaken simply on account of the fear many have of serious consequences following the removal of limbs in this climate. One of the first opinions the writer heard in Arkansas respecting the management of orchards, was from an old gentleman who said, "One thing certain, make a note of it, you've got to keep the knife away from trees down here, especially Ben Davis. I have seen more trouble down here from pruning than from all the other bad orchard practices combined. Trees won't stand pruning down here. It is a different climate from up North; and I have seen more than one northern man come down here and ruin a good orchard by not taking that into account." This opinion, which is more or less prevalent, I have found to be absolutely without foundation as far as the simple removal of limbs is concerned. The opinion originated not in the practice, however, so much as in its abuse. To hack off limbs roughly, with a hatchet, and to attempt by means of hatchet or axe to convert low-headed trees into high-headed trees, is a sure means of producing disastrous results. Orchards are frequently seen where such pruning has wrought sad havoc with otherwise good trees. Orchards have often been killed in this way. The mischief was in ignorance, not in pruning.

Limbs of almost any size may be removed if the work is done right (see Figs. 16, 14, F. G.), while the removal of a branch one-half inch in diameter may result in injury if it is done badly. There is unquestionably a greater necessity for care and correct pruning here than in some other sections. There is more of a tendency of the bark to dry and die back in the case of stubs, and careless pruning, but if the work be done correctly pruning may be done here without any danger whatever, the same as in other sections of the country. Bad pruning is more common than correct pruning. Hence the origin of the present ideas concerning pruning, and the common neglect of this useful practice.

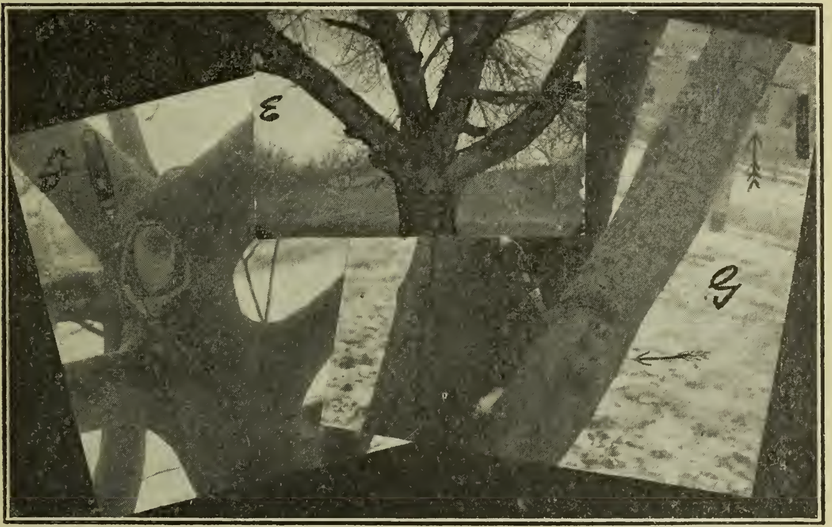

Fig. 14.—Pruning: E—Butchery; F—Correctly cut and healing; wound at one year; G—Correctly cut and healed. Four years after wound of limb.

Lately, in riding along the country road, the writer has seen several instances of "villainous work" in orchards, which the owner intended for pruning. (Fig. 14E.) Fresh stubs, varying in size from an inch to three inches in diameter, and as much as eight inches long, were visible in abundance from the road. Sometimes a good pruner, or the owner takes this method of marking limbs which he wants removed, leaving the stubs to be sawed off, by a cheaper man. I found myself hoping that this was the design in this instance, but from what I observed in many other instances fear I was indulging a vain hope.

No pruning is bad, but bad pruning is worse, while ''good pruning is manure.'' There is no way to do good pruning but to do it with a thorough understanding of its object. The mere matter of sawing out a limb is simple—so simple, however, that it sometimes seems to be the worst stumbling block in the practice. The fundamental facts in pruning are these: The tendency of the tree is to produce more buds than ever grow into branches; more branches than can produce good fruit; more fruit spurs than bear; more leaves than can find proper exposure to the light; more flowers than set fruit, and more fruit than can be developed, according to the standard of size and quality, desired by the grower. Every part produced, whether it will answer the ends of man or not, draws upon the resources of the tree and soil. There is a struggle going on in the tree top for space and food. Some parts get more, some less. To the parts most favorably located fall the chief function of carrying on the work of the tree. The parts unfavorably located cannot support themselves, much less contribute; but become in their efforts essentially parasitical on the rest of the tree. There is not enough food to sustain and develop all the parts as the soil fertility becomes reduced. What is going on in the top is to some extent repeated in the soil. It becomes increasingly difficult to extend the thousands of root tips as the soil fertility diminishes. The soil occupied by the root system becomes exhausted. The roots cannot extend into fresh soil, and reciprocally the top comes to a standstill with its thousands of buds to be fed. To a more or less marked degree there is a tendency in old orchards not properly cared for to reach a sort of equilibrium, or standstill condition, which, unless help comes is the beginning of decline.

We may shake the tree out of this drowsy condition by supplying plant foods directly, and indirectly by cultivation, or by pruning, temporarily reducing the number of parts above ground to be supported. These means disturb the ''balance.'' They increase food supply and cell turgidity, essential conditions for growth. Pruning acts like increased food supply. The parts left get all now while formerly the supply was shared with thousands of other mouths. The growth made is vigorous, healthier foliage is produced, new root tips are pushed out into soil not occupied before—more food is absorbed—which in turn affects the growth above ground—and what fruit there may be, having increased nourishment, makes up to a greater or less extent in size and quality the reduction in numbers.

The general rejuvenescence begun, however, is not permanent in an exhausted soil. The vigor of the tree and its ability to yield good crops cannot be kept up indefinitely by pruning alone under orchard conditions. It is only part of the process. Cultivation and the supplying of plant foods should now supplement the work begun, together with some pruning each year for the removal of unprofitable competition among the parts of the tree.

All this kind of work nature does in a rough way suited to the conditions found in nature. She lops off branches freely, by means of shade; she gives the soil in time to the strongest tree, thus increasing the food supply to the survivor—she manures the ground with foliage, the remains of her trimmings, with dust carried by the winds; nitrogen brought to the soil by rains and snows, by the beneficial action of frost, heat and air. Time is long, life short. Man's trick and shrewdness consist not in following nature, but her hints, and going farther, intensifying natural processes for quick and magnified results.

> "This is an art which doth mend nature
> Change it rather—but the art itself is nature."

Pruning gives each leaf as completely as possible full exposure to the light, and the chance to do its work without interference from its fellows. Under the conditions it is less liable to disease. What the leaves produce in the way of elaborated sap is now directed to the points where it will best subserve the purposes of the orchardist instead of being used in the support of unprofitable parts.

In carrying out these ends the orchardist

1. Removes dead and dying limbs, or broken limbs;

2. Limbs which cross and are liable to rub when shaken by winds:

3. Limbs originating and growing too close together and tending to compete with each other for the same position;

4. He cuts back limbs which growing too strong, tend to unbalance the head of the tree;

5. He thins out brushy growths of twigs;

6. He "heads back" trees or branches tending to grow too tall

and unbranched, causing the head of the tree to be too open. By this means he can fill up gaps on any side of the tree.

7. Vigorous trees are pruned moderately to benefit the fruit;

8. Weak trees are cut back vigorously to stimulate growth and improve vigor;

9. Unprofitable varieties are cut back for the purpose of top-grafting, as described later;

10. Young trees are pruned to direct growth and shape the head of the future tree, according to the ideal of the grower, and to the demands of the climate. While in transplanting, the tops are cut back to correspond with the loss in the root system—injured by removal, and pruned more or less for the removal of bruises and dead fibres. Fig. 15.

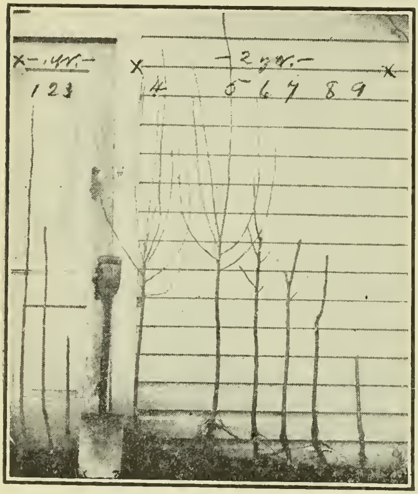

Fig. 15.—Young apple trees—at the left 1-year trees, at the right 2-year trees. Nos. 1, 4 and 5, unpruned; Nos. 2, 6, 7, 8, cut back for forming heads at 3 feet from the ground; Nos. 3 and 9, stub pruned for facility in planting and formation of low heads. Such stubs usually produce a strong leader, and may be made to form heads at any height desired.

11. The roots of young trees are often cut back severely aside from removing dead fibres, simply to stimulate the production of new roots in the soil, to which the young tree is transplanted;

12. Trees which grow too vigorously without bearing are sometimes root pruned, as one of the means of checking the vegetative function and stimulating the reproductive. It consists in digging a circular trench some feet from the tree for the purpose of locating the large roots—One or more of the strongest of these, are severed.

Theoretically the removal of sound limbs once formed should seldom be necessary, but practically it is often necessary. If we would escape pruning we must make it a directive process, rather than a corrective. Few, however, are able to give the young orchard the careful training that will obviate the necessity of the removal occasionally of more or less large sized limbs.

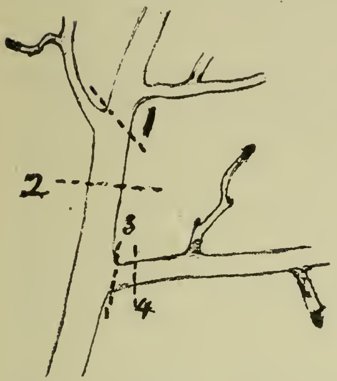

Fig. 16.—Diagram illustrating "heading in" and pruning. 1—Correct cut; 2—Incorrect cut; 3—Correct position for making cut in removing a limb; 4—Incorrect position.

The removal of limbs being often desirable and indeed necessary, then the consideration is to remove the limb without injury to the tree, or without the bad effects that may follow when the work is carelessly or improperly done. To this end, if a limb is to be wholly taken out, the cut is made close to and parallel with the limb to which it is attached. (Figs. 16 and 14, F, and G.)

This brings the wound close to the current of sap movement and active growth in the parent limb, so although the wound may be larger, it is readily healed. If a stub is left, dying back, and decay are likely to be the results, since cambial activity is almost, if not wholly suspended at the end of the stub, and healing cannot take place. If even a small branch be left at the end of such a stub cambial activity continues and the chances of healing over the end of the stub are greatly increased, if not made certain.

In the next place, all wounds over one-half inch in diameter are painted over with a material to keep out moisture and prevent decay. This material should be either waterproof or antiseptic, or both. White lead and linseed oil (without turpentine) make a good covering for wounds. Other materials are: hot grafting wax, pine tar, hot paraffine, boiled gas tar. The unboiled gas tar is less desirable. Wounds on trees at the station painted over with unboiled gas tar tended to die back at the edges, and heal more slowly than wounds protected with other substances.

Again pruning is done at the most favorable time, and only to the extent necessary for the purpose in view. If the operator cannot give a good reason for the removal of a limb, he should not remove it.

Pruning in which the saw is necessary is done as a rule in the dormant season, or soon after the growth commences, before the tree has spent part of its energy in the production of unprofitable growth.

Trees liable to bleed, however, on account of their diseased condition are best cut back late in the summer or early fall. In extensive work in pruning trees I have had not trouble with bleeding in trees pruned late in the summer and fall.

Moderate pruning may well begin on any trees in late summer and early fall. It is a pleasant time to work and there is that much done and out of the way for spring. We commonly are afraid of starting late growth, and rendering the tree susceptible to winter-killing of the fruit. I have not had any evil consequences follow light pruning. If heavy pruning is needed it is better to wait till later.

THE "HEADING IN" OF APPLE TREES.

"Heading in" is not necessarily injurious, but beneficial when called for and if done correctly. It simply amounts to so much pruning. In the station orchard an experiment on a number of kinds demonstrated this to the fullest extent three years previously. One was "topped in" the other left without it. The following year fruit from the topped in trees, and from the trees not topped gathered in baskets and placed side by side showed an increase of one-third in size from the topping; and in no case any dying back, or other injury whatever from the "heading in." On the other hand, in the time since, the signs of "heading in" have disappeared almost completely. The limbs cut were one inch to one and a quarter inch in diameter where cut. The cut was always made just at and above a smaller or larger sized branch. (Fig. 16[1].) To cut off the limbsin such a manner as to leave a bold stub, with no side twig or limbs, is very apt to be followed by dying back. "Heading in" is a special kind of pruning and should be resorted to only when necessary. The tree may be growing too tall, lop-sided. The upper part of the top may be too open. There may be a gap on one side which it is desired to fill. In the case of feeble trees the top limbs often begin first to show signs of failing. In such cases "heading in" is desirable.

CLOSE PLANTING.

This is a mistake growing out of the error discussed under the heading "Are apple orchards short lived?" It, in connection with early bearing, over bearing, is only a method of hastening soil exhaustion. It is fire at the other end of the lighted candle. Feeding the trees, pruning, cultivation, may delay the evil effects but they are sure to come in time, and help strengthen the conviction that apple orchards are short lived in this region. Close planting, aside from its evil effects otherwise, greatly interferes with work in the orchard after a few years. Trees at twenty-five feet if they do reasonably well, at twelve and fifteen years will have the limbs meeting between the rows. "True enough. We expect that. Orchards are short lived. We cut them down about that time." "As for interference with spraying, that's not so, for most of us don't spray anyway." And that's so also. But why not give the trees a little more room? Then we will not have to cut them down at fifteen years, and we *can* spray, if in the course of the years it at least enters our heads that we want to spray. The sight of a sixty-acre orchard stationary from close planting and starvation, but in sound condition, abandoned at fifteen years as having "seen its day" while the owner has planted out near by a young orchard to repeat the story, is truly a sober sight. Such a sight is like that of a great factory in which the wheels are silent, not because worn out, not because there are no operatives, but because there is a screw loose.

The expense of growing the new orchard expended in the old in caring for it, would in many of these instances lengthen its life ten to twenty years, put it to work at once and maintain the old orchard in vigor; grow the young orchard (if wanted), support the family, and make the owner and his banker smile.

Thirty feet is as close as apples should be planted, except possibly in the case of some of the dwarfer growing sorts, or where early bearing "fillers" are used between the regular kinds, to be cut out in a few years. See remarks under this heading, Bull. 71 Ark. Exp. Sta. pp. 7, 8, also remarks in the same bulletin on the subject of "Over bearing."

"Over bearing" like close planting, tends toward an earlier exhaustion of the soil's available fertility. It is noticeable that there are apt to be two to four "off years" following an extra heavy crop, and that as the trees get older the fruit is usually smaller. This is due to the increased amount of top to be supported—the production of more apples at one time with a relatively greatly reduced avaliable supply of plant food in the soil. In the resultant enfeebled condition it becomes increasingly difficult for the tree unaided to extend the thousands of root tips into fresh soil. As incidental to close planting the advancing army of root tips from one tree meet those of a neighboring tree. The roots in time thickly pervade the soil and the competition for food becomes sharp. Under such conditions, after a few years, a tree gathers up enough strength for a crop of fruit but without aid the element of time is required. Under the conditions, as if fearful that each crop may be its last, the tree at intervals makes a giant effort at reproduction and there is a tremendous crop.

The orchardist chuckles, and gathers it perhaps with a feeling of satisfaction over the rewards of his skill, and then next year there is a light crop. next year the frost gets the fruit, and then there are perhaps two "off years." Or we have this story with variations. It is laid at the door of frost, or of the severe winter. The frosts and freezes are responsible for some of the "off years" of course, but not all of them. What has been said above explains much.

When a few immense crops have been produced by a tree on the ordinary orchard soil the off years become more frequent. It simply means that it is impossible to produce big crops every year on the limited supply of plant food. There must of necessity, as a rule, or on average soils, be an interval between crops—and the larger the crop the longer likely will be the intervals, depending on the fertility of the soil. The tree finds it increasingly difficult to "scrape" together the strength for a crop. An orchardist in the fall of 1903 grew a crop of sorghum in his bearing orchard. This was cut for hay. The following year the crop in this orchard was about 60 per cent less than the average yield in other nearby orchards, under similar conditions but not cropped with sorghum. The year was one of light apple crops in most orchards, but it came nearer being a complete "off year" in the sorghum cropped orchard than the others. The orchardist simply took from his apples a portion of the already limited food supply. The food supply affects the ability of the tree to bear. If we get it all in one year we must expect to do without apples, or with a reduced supply till the tree gets ready for another "bumper" crop.

Aside from soil exhaustion and over bearing as factors in the matter of "off years," the great reduction in the foliage caused by apple scab is an important factor. The effects of diminished foliage are like those of poor soils—partial starvation. Freezes are responsible for some "off years," but most "off years" are not a necessity, neither from the standpoint of the season, tree or man. We cannot control freezes, but we can control the other factors. We can prevent over bearing. We can prune. We can fertilize. We can spray. The wise plan is to use all means. By so doing we could prevent two to three of the "off years" out of four at least.

Fair crops each year are better in every way than heavy crops at long intervals. When trees tend to over-bear there are often large crops everywhere. Under such conditions the price of apples is likely to be low. By having apples in the "off years" better prices are likely to compensate for all the trouble and for even a lessened quantity. Besides we are prolonging the life of the orchard.

CULTIVATION OF BEARING ORCHARDS.

In rich lands, and in regions where there are not such dry late summer conditions the method of seeding down the apple orchard to grass and mowing the same to mulch the ground, which we hear some recommending in recent years, may give satisfaction. It is not suited however to the orchard conditions found here as a general thing. Cultivation, and the use of fall and winter cover crops is much better.

Cultivation should be kept up in the average year throughout the growing season of trees. This means from the time in the spring the ground is dry enough to cultivate till the last of July, at least, and later if the conditions are dry. The summers here are long and cultivation should be continued a few weeks later than at the North. When cultivation is neglected or stopped early, there is a tendency to early maturity of the shoots—shedding of the foliage, and a second growth. The characters of our seasons may be better understood when I say, at the Experiment Station, it is possible frequently to grow two crops of asparagus in a single season. This has been done, and the second crop was almost as good as the first. This would not be a good plan to follow regularly. It would exhaust the plants. The second crop was the following spring's crop simply brought out in the fall. We have a tendency toward the same thing frequently in apple and other trees. A second bloom was noticeable in many orchards in September and some trees had the appearance of being in almost full bloom. This is a serious thing and does not bode well for the crop of fruit on such trees the succeeding year. Those spring flowers should be kept back till spring, and it is a thing within the power of the orchardist to do.

It was noticeable that the second flowering was most abundant in orchards where cultivation was the most neglected, or wholly neglected. With this, the trees had not been sprayed or pruned. The leaves had been shed largely in August. As I see it, the meaning of it all is, in orchards uncultivated and unsprayed there is an early shedding of the foliage. Warmth continuing with fair supplies of moisture available, no foliage to evaporate it, there is a disposition to push out more foliage and growth. The dormant period begun is broken. It is a late summer awakening of the spring activities in the tree, of which the flowers are the heralds. It is too late in the season for their development, or the development of other fruit buds. This is the very thing many growers seek to avoid by stopping cultivation early.

It was noticeable the past season that in cultivated orchards there were very few fall flowers, while in the orchard under the writer's charge where the trees were sprayed and cultivation was continued into August, there was not a flower opened. These trees carried fully half their foliage in good condition till October 26th, and all was not shed till early in November. In cultivating the orchard some trees in a few spots not easily accessible to cultivation, were skipped. These shed their foliage mostly in August and September, and by October 16th were wholly leafless. On these leafless trees numbers of flowers pushed out, more on some than on others.

As the shedding of foliage is not wholly a matter of cultivation, but is brought about partly by the scab fungus, spraying would help also in the matter of bringing about a later retention of healthy foliage.

There is a prejudice against cultivation on the part of some growers. Some do not appreciate the necessity of it. Some who have tried it condemn it. A single instance will illustrate the nature of such prejudice: In an old orchard long without cultivation, cultivation was tried and continued three years, then discontinued. Every tree in the cultivated block of the orchard died out after a time, the owner says, and now his opinion of cultivation is, that it is injurious.

Another orchardist decided that he would take up cultivation after long neglect. He went into the orchard with a two-horse plow and ran it eight to ten inches deep, tearing up large roots. This man is not an advocate of cultivation, but has gone back to the "natural method," and appears to believe that the less care one bestows upon apple orchards the better the success. However his success would fall far short of satisfying the writer. His trees are in very feeble condition, many have died or are dying, and last year's crop went mainly to the evaporator and vinegar works.

If orchards in sod are giving satisfactory results it is best to "let well enough alone." If not, then one should cast about for a means of putting the orchard into better condition. Cultivation will likely be a good move, in connection with the use of suitable fertilizers. It should be shallow, however, not over three or four inches deep. The object is not to stir the soil deeply, but to kill the grass which makes heavy drafts on the soil moisture. Once begun it should be continued regularly each year. The tendency is to encourage a deeper formation of feeding roots which helps the tree in going successfully through drouths. With the looser surface soil the feeding roots can run deeper and still get the supply of oxygen which roots need. To continue cultivation for a few years, then suddenly suspend it, is more or less serious obviously, according to the nature of the soil, etc. It is attended with a reduction in the supply of oxygen and probably the death of many feeding roots.

CULTIVATION OF YOUNG ORCHARDS.

Real plowing in an orchard is best done before the orchard is on the ground. The soil should be well and deeply worked in preparation for trees. Cultivation should be deep the first two or three years, except near the stem. One should keep a foot away from a tree the first year, three the second, and four by the third. The first three years the plow should be run from six to eight inches deep. This has been shown by investigation to lead to a deeper running root system. This helps in many ways, but one worthy of special mention in this climate, is that of making trees less subject to the effects of drouth, especially desirable when the trees come to carry a crop.

When the orchard has reached bearing age deep plowing is not needed. Plowing at all is unnecessary except for the purpose of burying herbage. Most of the work can be done by means of the disc—the cut-away harrows—the spring-tooth and the common smoothing harrow. If the work is attended to properly the soil once loosened in the spring may be kept in good condition by means of the last mentioned implement alone. A sectional harrow of light type, and eight or nine feet wide, is rapid and answers for soil not too heavy. A soil upon which a surface dust mulch is maintained will not become hard below and will carry trees through dry periods usually without injury from the drouth.

Cropping young orchards as a means of partly defraying the cost of growing is a common practice. The crop in most favor with orchard owners for the purpose is corn. This brings about cultivation of the land which otherwise would not often receive proper attention, so while the corn takes from the land part of its fertility the loss is in a measure compensated for by the tillage. There is usually enough available fertility in the land newly planted to orchard to support both crops for a few years. But the practice is robbing the future tree of elements which will be needed for the production of apples. We cannot cheat nature. The practice amounts to discount on commercial paper—we get the use of the money earlier, and likely spend it, and do without it later.

When crops are grown in the young orchard it should be the settled purpose of the orchardist to supply plant foods to the bearing orchard, to compensate for that removed by the cropping. It seems to be generally understood by orchard growers that the growing of any other than the cultivated crops in the young orchard is a practice to be rigidly avoided.

COVER CROPS.

The chief defect of much of our land devoted to orchard is a deficiency of humus, a constituent of the soil absolutely essential to its fertility. Apple crops are exhausting, and orchard lands in time become too poor to grow even weeds in some instances. This with the neglect of cultivation, or wholly clean cultivation, results in a hard, worn out condition of the soil, unsuited to the production of good trees or apples. Humus burns out, and frequently the humus is deficient in land planted to orchard as a result of previous cropping and unwise management. Soils rich in potash and phosphoric acid and even nitrates, may still be unproductive unless they contain a certain percentage of humus. Its presence in the soils assists in setting free or rendering available plant foods of the kind mentioned which are not otherwise available for the roots of plants. Humus benefits in other important ways. It should be the settled aim of every orchardist to maintain in his soil a fair proportion of humus. This is of more importance than the supplying of fertilizers—indeed without it only indifferent results are likely to follow the use of commercial fertilizers.

Stable manure, when obtainable, is an excellent source of humus, but it is not essential. Humus may be cheaply supplied to the soil by means of green manures—grown after the period of spring and early summer cultivation. When plowed under they decay, the residue forming this very valuable soil constituent. In run down lands more rapid results may be secured by growing both fall and winter cover crops. Rotation is desirable, as different plants have different power of acting on the soil ingredients.

Crops for the purpose are of two general types—leguminous, and non-leguminous. The legumes besides being sources of humus have the power of increasing in the soil the supply of nitrogen which they obtain from the air, a property peculiar to leguminous plants, or plants of the bean, pea and clover types. The non-leguminous plants, such as Indian corn, rye, oats and turnips, are not nitrogen producers but nitrogen consumers. Neither of these types add to the supply of potash or phosphoric acid in the soil though they are valuable means of increasing the availability of these substances when returned to the soil.

The uses of these annual plants when grown as cover crops are to increase the supply of organic matter in the soil when they have been plowed under, and protect soils against puddling and washing. They are a means of increasing the availability of plant foods already in the soil—and the leguminous plants afford a cheap means of increasing the supply of nitrogen in the soil—and either type may be the means of conserving or storing up for later use the supply of nitrogen already present, by taking it up in their growth and preventing its being leached away by winter rains. In increasing the supply of humus in the soil, they increase the soil's capacity for holding moisture during the growing season. They improve the texture of the soil, thereby facilitating tillage. These are among the most important considerations in view in making use of cover crops.

In worn soils it is well to make use of both types, and on all possible occasions between regular crops. Some of them are well suited for use as late summer or fall crops, and others as winter cover crops. The cowpea is one of the most highly valued summer crops,

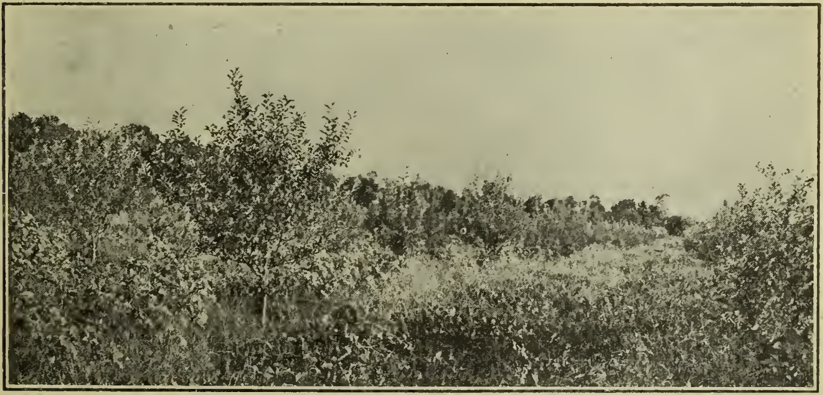

Fig. 17.—A young orchard; cow-peas for humus and nitrogen. Washington County.

for the purposes here being considered, but it should not be used continuously. It is well to rotate it with others from season to season after a year or two. Buckwheat, Indian corn (broad cast), sorghum and cow-horn turnips are useful.

Of winter cover crops crimson clover is a valuable legume for orchard lands. Unlike red clover, it is an annual. It pushes up early in the spring, when it may be turned under. It remains green throughout the winter. Hairy vetch is also valuable. It is frequently sown with rye as a winter cover. Rye is one of the most valuable plants for winter. By sowing cowpeas in drills, not too closely, and cultivating them—the above last mentioned cover crops may be sown between the rows late in summer to take the place of the cowpeas when killed by frost, where the growth of the cowpeas is not too luxuriant.

Cover crops should not be allowed to remain too long above ground in the spring. A moderate growth is all that should be aimed at. It is especially undesirable to turn under a "run away" crop of rye during dry conditions in the orchard. It is better to mow it and let the herbage mulch the ground; or remove it rather than plow under a heavy mat of fibrous material during dry weather.

A rank growth of herbage turned under is likely to cause some acidity in the soil. If likely to be considerable a moderate application of lime may be needed to correct the acidity. Apples, however, do not suffer from a slight degree of acidity as is the case with many other crops.

FERTILIZERS AND NOTES ON EXPERIMENTAL RESULTS.

The average soil not exhausted by previous cropping and poor management, contains sufficient plant food to grow the young orchard and produce a few crops of apples without additions in the nature of commercial fertilizers.

As soon as bearing begins in earnest, however, attention should be given to the maintenance of the soil's fertility, through careful tillage, improving soil texture, by the use of humus forming crops, and the application of the important plant foods supplied in commercial fertilizers. Our older bearing orchards as a rule are in need of potash and phosphoric acid, and sometimes lime. Where vegetative vigor is deficient and foliage small and pale, the need of nitrogen is indicated. Nitrogen can be produced in sufficient quantities in the land by increasing the humus, through tillage, and the use of legumes turned under, except where the nature of the case calls for an immediate supply of this element for stimulating growth. Care should be used not to over-stimulate growth, however, by using nitrogen too freely. In this matter the grower should keep his hand on the throttle, and speed under control.

Before resorting to the use of commercial fertilizers the grower should make use of all the ordinary means at hand for improving the physical condition of his soil. This done it will be time enough to make use of the purchased plant foods. Without attention to putting the soil into good physical condition fertilizers are not likely to be found as profitable as otherwise, or produce their full effects. Frequently attention to improving the physical condition or texture of the soil gives surprising results alone, and may prove to be for the time all that is necessary. The correct and economical use of fertilizers, and maintenance of the soil's fertility, are matters of fundamental importance to the orchardist, and others, and should be matters of careful study. The grower should possess for study and reference one or more of the several works on the subjects, to be had at a nominal price. "The Soil," by King; The Fertility of the Land, by Roberts; Fertilizers, by Voorhees; would be found of the greatest value. They may be had, through the horticultural papers as a rule, or direct from the publisher, the MacMillan Co., Fifth Avenue, New York. They cost 75 cents, $1.25 and $1.00 respectively.

Bulletin 47 of this station contains suggestions regarding fertilizers and manures. Bulletins 81 and 86 contain information about the brands of fertilizers sold in the State. Bulletin No. 71 contains under the caption of "Soil" brief suggestions regarding fertilizers for apple orchards. Farmers Bulletins Nos. 44-144-192, U. S. Dept. Agr., explain briefly the composition and use of commercial fertilizers.

The writer has always found the use of manures and fertilizers profitable and used them as freely the last season as circumstances would admit, in the old orchard. To weak trees and re-sets as well as old veterans, nitrogen in small amounts produced almost magical effects during the course of the season in renewing their vigor.

For effects on re-sets see later under the subject "Gaps and re-sets in the old orchard."

On larger trees ten to twelve shovelfuls of rotted manure were scattered beyond the ends of the branches, where it could later be turned under and where the feeding roots principally are found. Other larger trees not receiving the stable manure received three pounds of nitrate of soda in a trial of several kinds of fertilizers This gave a rich green color to the foliage, increased its size, and amount, promoted the general vigor, and assisted the trees to retain their foliage till early November, when other trees had shed their foliage long before. It increased the size of the apples on these trees to a size one-third larger than trees receiving a general fertilizer and very much greater relative increase in size over apples on trees fed with only one pound of the same nitrate fertilizer alone, or with muriate of potash alone three pounds; sulphate of potash alone, three pounds; or slacked lime 20 pounds. The fruit was not so well colored as that of other trees, and was later maturing. On this Clayey cherty soil very deficient in humus no marked effects followed the use of the other fertilizers mentioned above, when used separately. Lime seemed to help the foliage and color of the apples on trees treated, while the muriate of potash gave a very bright winesap red to the normally brownish Arkansas, or M. B. Twigs.

The sixteen-year-old block of Ben Davis, including a few rows of Arkansas or M. B. Twig received during the course of the year three tons of wood ashes per acre, three pounds per tree of a general fertilizer, a light crop of crimson clover turned under, and a good summer growth of weeds which early summer rains interfering with cultivation made possible. The block was moderately pruned also the preceding fall. It was also well sprayed with liquid. Here were produced the finest apples on the place and the most of them fine in color, 90 per cent sound, and running 330 to 360 apples (Bens) to the barrel. In view of the short crop I had undertaken to compensate for the lack in number by increase in size and had the satisfaction of being successful to a considerable degree.

Many growers who are interested in better care of orchards and the use of fertilizers write to the station as to where fertilizers may be obtained. From points outside the State the freight rates are practically prohibitive, owing to the railroads' classification in some instances, under the head of chemicals. Within this State very reasonable freight rates on fertilizers are allowed, the rate being in less than car lots $3.60 per ton and $1.83 per ton in car lots of not less than twelve tons, from Little Rock to Fayettesville.

There are abundant supplies of phosphate rock in the State of a superior grade, known through the labors of Dr. J. C. Branner, formerly State Geologist.* The supply of phosphate north of Batesville is being worked and placed on the market by the Arkansas Fertilizer Company, whose headquarters and distributing point is Little Rock. This firm handles other forms of fertilizers for various purposes, both separately and ready mixed, or mixed to order for special uses. There are only three things which the buyer need concern himself with in buying a commercial fertilizer, as follows: The amount percentage of nitrogen (N), the percentage of potash (K), and the percentage of available phosphoric acid (P_2O_5), what is spoken of as reverted or insoluble phosphoric acid is of no immediate value. The following analysis would tend to confuse some buyers or lead them to suppose the fertilizer contains more plant food than is actually present:

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* Ark. Agr. Expt. Sta. Bulletin No. 74, by John C. Branner and J. F. Newsom.

Analysis.

Nitrogen	1.66	to	2.00	per cent.
As Ammonia	2.00	to	2.75	per cent.
Soluble Phosphoric Acid	5.00	to	7.00	per cent.
Reverted Phosphoric Acid	3.00	to	4.00	per cent.
Available Phosphoric Acid	8.00	to	10.00	per cent.
Insoluble Phosphoric Acid	2.00	to	3.00	per cent.
Total Phosphoric Acid	10.00	to	13.00	per cent.
Bone Phosphate of Lime	21.80	to	26.16	per cent.
Potash (K_2O)	1.50	to	3.00	per cent.
Equal to Sulphate of Pot.	3.00	to	6.00	per cent.

The following extract conveys timely and valuable information.

"PLANT FOOD REQUIREMENTS OF BEARING FRUIT TREES."*

"The amount of plant food which mature fruit trees in the full vigor of bearing use in one growing season has recently been reported by L. L. Van Slyke, O. M. Taylor and W. H. Andrews, of the New York State Station. From one to three standard varieties were examined in each case. With each variety the fruit, leaves and new growth of wood, as represented by the extension of the branches during the season, were gathered, dried, and analyzed. The fruit on the different trees was picked when ripe. The foliage was left until it showed a tendency to drop. The twigs of new wood were removed soon afterwards.

The apple trees in the experiment yielded during the season from 23 to nearly 30 bushels of fruit each, the peach trees from nearly

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* Farmers' Bulletin No. 237 U. S. Dept.Agr., pp. 7, 8.—1965.

3 to over 4 bushels each, the pears from 1 to 5 bushels each, the plums from 1 to 1.75 bushels each, and the quince tree about 1.5 bushels. The following table shows the average amount of plant food used by each fruit tree of the different varieties studied:

Plant food used during a season's growth by a mature fruit tree in full bearing.

Variety.	Nitrogen. Pounds.	Phosphoric Acid. Pounds.	Potash. Pounds.	Lime. Pounds.	Magnesia. Pounds.
Apple	1.47	0.39	1.57	1.62	0.66
Peach	.62	.15	.60	.95	.29
Pear	.25	.06	.27	.32	.09
Plum	.25	.07	.32	.34	.11
Quince	.19	.06	.24	.27	.08

The above table shows the total amount of plant food used by the fruit, leaves, and wood of each kind of tree in one growing season. The figures might be considerably different with smaller younger trees, or larger older trees, or with trees not in bearing.

If the table is carefully examined it will be seen that—

the relative proportions of the different plant-food constituents are approximately the same for the different varieties of fruit trees. This means that, under like conditions of soil fertility, a mixture of nitrogen, phosphoric acid, and potash which would meet the requirements of one variety would also meet the needs of the other varieties, so far as the supply of these plant-food constituents is concerned. What particular proportions are best adapted to meet the needs of any particular soil can be determined only by special experiment.

Using the above table as a basis, the amount of plant food used per acre by the different fruits can be easily determined. The following table shows the data thus deduced:

Plant food used per acre by different fruit trees and by wheat.

Variety.	Number of trees per acre.	Nitrogen. Pounds.	Phosphoric Acid. Pounds.	Potash. Pounds.	Lime. Pounds.	Magnesia. Pounds.
Apple	35	51.5	14.0	55.0	57.0	23.0
Peach	120	74.5	18.0	72.0	114.0	35.0
Pear	120	29.5	7.0	33.0	38.0	11.0
Plum	120	29.5	8.5	38.0	41.0	13.0
Quince	240	45.5	15.5	57.0	65.5	19.0
Wheat	*a*20	39.5	12.0	16.2	....	....

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a Bushels.

This table shows that "peach trees used the largest amounts of plant food; apple and quince trees, approximately alike in the results given, come second, while pear and plum trees, which give results much alike, come third."

The amount of plant food used by a crop of wheat yielding 20 bushels of grain and a ton of straw per acre is included in the table for comparison. It can be readily seen that a heavy crop of fruit uses much more plant food during the growing season than a crop of wheat. If, therefore, it is considered necessary to fertilize the soil to secure a crop of 20 bushels of wheat per acre, it would seem even more necessary to fertilize for a crop of fruit.

The table shows further that—

> the amounts of nitrogen and potash used by any one kind of fruit trees were approximately the same in most cases, while the amount of phosphoric acid was only about one-fourth the nitrogen or potash. In most commercial fertilizers used on fruit trees the phosphoric acid is present in proportions about 4 times the nitrogen. This is on the assumption that the soil contains more nitrogen relatively than phosphoric acid, which may or may not be true in individual cases.* The question may be raised as to whether quantities of phosphoric acid are not frequently applied much in excess of the actual need of a season's crops."

GAPS AND RE-SETS IN THE OLD ORCHARD.

There are a number of re-sets in the orchard in the places where old trees have died, or been taken out. A number of these vacancies are due to root rot, the greatest loss has been in the eastern part of the orchard which is newer ground, and still dotted with decayed stumps. The greatest number of vacancies are in the lower and moist portions of the ground, although trees have also died here and there of root rot on the higher grounds. The drainage has been improved and many of the old stumps removed and vacancies have been filled with young trees. It is often considered useless to plant young trees in the places where old trees have died. This is undoubtedly the case, unless special pains be taken to enrich the soil and in the matter of cultivation about the new trees.

I have never seen re-sets among old orchard trees thrive without such attention. With it however it is possible to have the young trees grow as vigorously as in new soil as will be seen further on.

The re-sets planted in the old orchard received no special cultivation the first season following planting, in the way of enriching the soil. Few of them made a growth during that year of over six to ten inches. Many of the trees stood almost still while some died. The following year the same re-sets were cultivated and received each two to four shovelfuls of rotted manure scattered about the tree, others not receiving manure were given a pound of nitrate of soda, scattered like the manure, around the tree. This was done in two equal applications in the early part of the season. Nitrate of soda answers fairly well in the absence of the manure.

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* See P. 158, where analysis of soil showed an excess of phosphoric acid in poor soil.

The effect of the nitrogen was promptly visible within a week after the first application was made, in the darker color of these trees, as compared with other re-sets near by left unfertilized for purposes of comparison. After a few weeks the difference between the fertilized and unfertilized trees was so pronounced as to be conspicuous to all who saw them, although ignorant of what had been done to cause the difference. The difference became more pronounced as the season advanced, the surprising growth of the re-sets was noticed and commented on by passers by, one of whom ignorant of the treatment given, remarked that he had never seen re-sets show such vigorous growth. Those fed and cultivated during the summer increased in height from two and a half to four feet; increased also in stockiness of stem and branch in a corresponding manner, while trees not receiving this care made only slight growth.

Experiments have been in hand at the Arkansas Experiment Station during the past three years to determine what success may be had in the matter of replanting the gaps in the orchard where old trees have died. Owing to the demands for room for new college buildings the small variety orchard near the station building had to be grubbed out. An examination of the resets which had been under observation showed a fine vigorous growth in all. In planting out the young trees holes three and a half feet across and eighteen inches deep were dug. Particular attention was given to the removal of all old roots especially in the places where the old trees had died of root rot. The soil removed was scattered about thinly on the dry surface of the soil. The hole was sprinkled with sulphur at the rate of a pound to the opening. The holes were left open the balance of the summer. At the time of planting the trees in the fall fresh soil was brought. When the trees were dug out the past fall eighty-five per cent of the re-sets had sound bodies and roots. The remaining 15 per cent, although they had made a good growth, showed a diseased condition of the roots and the presence of the fungus characteristic of root-rot.

In digging out trees killed by root rot or otherwise, I have been following lately the plan of digging out a large opening. The tree is then cut up and piled to dry over the opening. After a few weeks in summer the brush is sufficiently dry. It is then burned on the spot. That gives back to the soil some of the constituents previously used in the growth of the tree. Besides heating up the soil and tending to destroy the remains of the root rot fungi.

Young trees should always be cut back at the time of setting. This is necessary on account of the injury done to the root system in removing them and in order to start the branching and future head at the desired height from the ground. The planter should always have in mind an ideal orchard tree and follow it from the very start. My own preference is for low headed trees, trees with branches beginning three feet from the ground, with the branches borne some inches to a foot or eighteen inches apart, along the sides of a leader or central axis, maintained more or less distinctly through the life of the tree. In some soils and localities I should adopt the style of three main branching branches. One year trees without branches I cut back to three feet. This induces branches. One of the most upright is selected as a leader to carry upward. This process is repeated each year with some summer nipping of stronger branches and thinning out of the limbs not wanted. In the case of branched stronger trees, those having branches at suitable height, the side branches are thinned out so as to have them at different heights and equally disposed around the stem as an axis. (See Fig. 15, p. 174.)

Both in setting the tree and pruning it, care is taken to have a good branch low on the south side. Side branches are cut back to two or three buds or left longer according to the strength of the limb. The leader is cut back eighteen inches to two feet above this and the plan followed from year to year with attention during summer for preventing superfluous branching.

TOP GRAFTING OLD TREES.

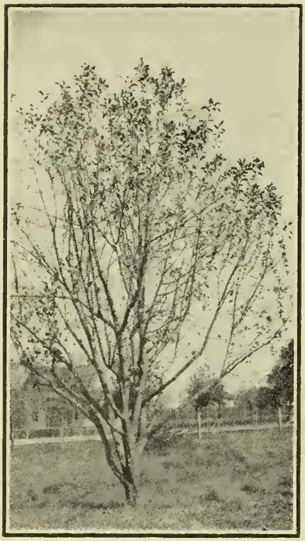

Fig. 18.—Top grafted apple tree. Fourth year.

Fig. 18 shows a tree on the station grounds, which by top grafting has been changed from an inferior sort a good variety. The tree is shown the fourth year after ''top working.'' In a successful instance known to the writer a large block of winesaps, which proved unprofitable, were top-worked with scions of Ben Davis. In three years they were converted from an unprofitable into a profitable sort. The process need not cost over ten to fifteen cents a tree and is indeed an excellent plan. It is far better than grubbing out trees and waiting for the orchard to reach profitable bearing age, which is about seven years. Top grafts begin bearing the third year as a rule. The process is simple and may be performed by any one who will exercise reasonable pains.

At the beginning of the growing season or a few weeks earlier, the leading limbs are sawed squarely off by a clean cut at a point where the diameter is from one inch to two inches. The other limbs are not removed at once, but left until the grafting has been found successful, when a portion of them may be cut away. The stub is cleft with a broad and thin bladed knife, made for the purpose, which can be had of implement dealers. With a chisel-shaped point the cleft is pried open and the scion having its base cut wedge-fashion, inserted. Special pains should be taken not to split the large limbs any farther than is necessary, and in trimming and inserting the scion so as to secure as good a fit as possible and have the cambium layer of the scion on the outer side meet nicely that of the stock. Only one scion in each cleft is needed on a moderate sized limb. The grip of the cleft makes tieing unnecessary, but it is desirable to paint over the cut surfaces with hot grafting wax. This prevents drying and keeps out water and decay. Some operators instead of splitting the stock saw a long V-shaped cut on one side of the stub, and drive the scion, trimmed to fit, into place, covering with grafting wax as in the other case. There are other variations resorted to under special circumstances.

The last described avoids splitting the stub and is well suited for large limbs. A short time after growth starts on other trees an examination will show whether the operation has been successful. In growing plants, about fourteen days are required for the formation of the union. With reasonable care there need not be one failure in a hundred.

When it is apparent that the graft has "taken" a few of the limbs below may be removed to throw more strength into the grafts. Later in the summer, as the grafts gain strength a few more may be taken out. By the beginning of the second season all may be removed and the full energies of the tree directed into the grafts. Unless watched water sprouts may interfere. The removal of the ungrafted limbs in the tree top is a matter of discretion, except it is better to do it gradually than all at once, and not till the grafts have made some start.

Grafting wax may be made as follows:

Resin, 4 lbs.
Beeswax, 2 lbs.
Tallow, 1 lb.

Melt all together and apply hot, or pour hot wax into water and pull till it becomes light yellow, first greasing the hands. For use in warm rooms increase the resin to 6 parts and use 1 part each of the other ingredients. The substitution of 1 pint of linseed oil for the tallow gives a good wax for applying hot in top grafting.

CARBON BISULPHIDE FOR KILLING SASSAFRAS SPROUTS.

A great deal of grubbing was done in the orchard to get rid of sassafras sprouts. The grubbing was done in May and August, but all know how difficult it is to free the ground of sassafras. It is a perennial task. Experiments were tried with several chemicals for the destruction of these sprouts. The substances tried were cold tar, salt, zenoleum and carbon desulphide. The results were only partially successful with the first three substances, but entirely satisfactory with the carbon desulphide. These materials were applied to the lower parts of the stem July 20th. On the sprouts three to five feet tall a teaspoonful to a tablespoonful was used. It was poured down the stem, beginning six inches above the ground. This portion of the stem turned brown in a few days. The top of the plant was brown and dead in a short time. At the end of the month several were dug up in order to examine the root. They were old roots in some instances which had been cut off several times before. The roots treated with the carbon desulphide were dead to the end of the roots taken out, the heart-wood being discolored.

This material costs 10 to 20 cents a pint. It would be more expensive to use it than the grubbing hoe but it would be cheaper in the end for the scattering sprouts, which persist in pushing up in spite of the grubbing hoe.

PROTECTION AGAINST RABBITS.

Mr. W. B. Alwood of the Virginia Experiment Station, several years since called attention to the merits of white lead paint applied to young trees as a protection against rabbit injury. The writer has since used it in an extensive way on young apple and peach trees. It has given the greatest satisfaction. Care is taken to get only pure white lead and pure linseed oil. No turpentine is used in the paint applied to trees. Other oils in the paint, like kerosene and gasoline, would be likely to endanger the life of the tree. For this reason the use of ready-mixed paint, the composition of which is unknown, is attended with risk. There were heavy snows last year and again this winter. It is during such times rabbit injury is likely to be worse. A few trees were gnawed last winter out of several hundred painted, but this was the fault of the laborer who applied the paint. He was so afraid of injurious effects that he applied only a very thin coat. The past fall a good white coat was given the stems of 2,300 young apple trees and 2,000 peach trees in orchard plantings. Two heavy snows have occurred since and examination shows not a tree gnawed. The paint extends from the ground up the stems three feet. The presence of a crop of green herbage, like winter rye, spinach, etc., has been found to give a large measure of immunity. It affords the animals the food they are after and in this way it affords protection to the trees. The writer's plan has been to use both methods.

Veneer strips which may be had at $4.50 to $5.00 per thousand of box and basket factories are satisfactory. They are soaked in water preparatory to use. They form a tube about the stem four inches in diameter when bound with wire, and are left about the trees till they decay. Bundles of these strips, while in the flat, may have the ends dipped in coal tar. The dipped end is then placed downward. The object is plain. Corn-stalks, rye straw, paper, ropes of twisted grass are sometimes used but are more expensive than the means be beforementioned. Thrifty trees which have been successfully protected from rabbit injury are sometimes killed by subsequent inattention to removing the wires or the strings used in binding the protection in place.

THE HANDLING OF APPLES.

Ten boxes and five barrels of apples were placed in an ordinary thick walled cellar above ground, to observe the causes of decay. I will not take up these results here in detail but only say, that the main causes of decay were bruises. The other factors were very secondary as compared with bruises.

(1) The bruises were of two kinds, small bruises originating in careless handling of the fruit by the pickers,

(2) Large bruises resulting from the crushing of the riper specimens by the harder specimens in pressure of the fruit when heading the barrels.

The pickers and others were cautioned repeatedly to "handle the apples like eggs." In spite of this it was surprising to find what a large proportion of the fruit contained two and three small bruises. These bruises, whether the skin is broken or not are extremely serious, sooner or later, and should be avoided. There is no way to do this except by employing conscientious help in the harvest, and if necessary, employing three or a half dozen persons whose sole business shall be to watch the work of the others. In the hurry of barreling or packing it is impossible to detect small bruises, but careless handling can quickly be seen.

The second class of bruises results from two causes:

(1) Unequal ripeness of apples put in the same container,

(2) Pressing the contents of the container too much.

As for the first matter, the best growers now recognize the fact that it is desirable to make two or three gatherings instead of a single one. This results in getting together fruits of equal ripeness, and as the fruits are not gathered till fully colored and matured it improves the quality, the color, and enhances the keeping of the fruit. One of the reasons for the Ben Davis having a worse reputation than it deserves for quality, is gathering all the fruit with the maturity or coloring (often premature) of the first specimens. The grower becomes fearful lest the apples will get too ripe and makes the mistake of getting in too big a hurry. Making two or three gatherings would enable him to save all and do much to relieve the hurry, besides improving the packing, grade of the fruit, and its keeping qualities. The time to pluck an apple is when it don't need plucking—but separates from the stem when lifted by hand with a slight twist. It should never be pulled off. The spur is likely to come with it. The time is when the apple is just mature, fully colored, but before it has begun to mellow.

The other cause of bad bruising, is simply the use of too much pressure upon the fruit, as well as careless pressure. The fruit is heaped too much. If the barrel, when packing, is shaken frequently, say every time a half bushel of apples is put in, there will be no occasion for heaping the barrel. Slightly above the chine is sufficient where they have been well settled in the barrel by frequent shakings as above. The rule is to have a board or some solid surface under the barrel. Pack fruit only sufficiently tight to avoid damage from hauling and rattling.

If to be held long in storage shrinkage will result in the apples becoming a little loose any way, so that the apples will need packing or tightening with ''extra heads'' and ''mats.'' In case of decay apples should be ''re-run.'' The apples do not go back in the barrel in the original position and repressing results in well-nigh doubling the number of bruises. Carefully packed apples, sold from storage before the holidays should not need re-running. A little ''plugging'' should be all that is necessary. For those kept later re-running may be necessary. The pressure at this time need not be as great as that usually applied in the fall before shrinkage, so, much bruising is avoided.

The weather is usually warm during the apple harvesting season. It was warm last fall and continued so for some weeks after gathering. When gathered the ripening progressed rapidly. Prompt chilling of the fruit only will arrest this. For this reason barreled fruit intended for storage should be promptly hauled out of the orchard and placed in cold storage. If that cannot be done it would be well to place it in open boxes in an open, airy shed, to cool over night, or upon a large culling table or platform in such a shed for running over the cull table in early morning while the dew is drying off the trees and ungathered fruit. A frequently used plan is to pack the barrels in the orchard without heading up, and haul them, several at the time, on a low runnered float or planker to the shed for heading up in the early morning.

Careful attention should be given to grading the apples. Mixing No. 1 and 2 grades do not make the No. 2 sell as No. 1s, but makes the No. 1 grade go as No. 2. Extra large specimens should be packed to themselves. Mixed in with the average sizes they disfigure the grade rather than improve it. The grades should be uniform. At least each package should contain an uniform size. Inferior grades should not be packed and shipped. If the grower is in the apple deal to stay he had better throw them away than put them on the market, especially with his name on the package. Poor fruit lowers the price of the good and curtails consumption instead of encouraging it.

SPRAYING—WHY?

The question with many is not how to spray, so much as will it pay? There are many who do not spray because they have heard of cases where it did no good, or where some who did not spray had as good fruit as those who did spray. Some have tried it themselves and condemn it as a waste of energy on the basis of their own experience. Others simply do not understand the nature of fungus diseases, or insect injuries sufficiently to realize the necessity of combatting them; or how spraying can prevent such losses. Poor pumps, nozzles, lack of agitator on pump, impure materials, or the wrong materials, are some of the factors which result in failure in spraying. Again rains may cause the grower to delay spraying till too late, or they may wash off the spray before it has been on long enough to have its effect.

In the preceding pages the evidence seems sufficient to answer conclusively the question, ''Is spraying effective?'' (See Figs, 12, and 3, 4, 5, 6, cover, and 13.) Other instances have come to light the past season where spraying gave fair crops of perfect fruit, while neighboring orchards almost or totally failed to produce any marketable apples whatever. These instances show that ''off years'' in neglected orchards are not necessarily ''off years'' in sprayed orchards, and give a hint as to the nature of some of the ''frosts'' and ''weather conditions'' that some are inclined to blame for apple failures.

It is true that spraying in some hands has failed to pay. It is true that sometimes the man who doesn't spray has as good fruit as the man who does, but these things do not demonstrate the inefficiency of spraying—they merely show the operator has failed—in some respect; that good fruit, if obtained without spraying, was obtained because the pests for some reason were not troublesome as usual.

Merely spraying does not insure results, but thorough spraying, timely spraying—spraying with the right materials and the right preparations, does. It will not prevent all damages. That is well-nigh impossible. It will in the case of various pests prevent 75 to 95 per cent of it however, if done right; and this has been demonstrated over and over in thousands of careful tests both in a small and large way. It should not be relied upon alone to remedy the ill effects of neglect, or poverty of soil. It is only one feature of good care. It will yield results, but the most satisfactory results where it is the means of protecting from injury the fruits of otherwise reasonable care.

For those who neglect spraying on account of not fully understanding the relation of the means to the end, I will undertake as briefly as possible to explain the relation.

WHAT LEAVES DO.

The leaves of a tree are in a sense, as to function, both lungs and stomach. They absorb oxygen and carbon dioxide from the air through very numerous, minute mouth-like openings in the otherwise continuous skin-like epidermis. In the spongy tissue composing the inside of the leaf, through the action of sunlight the carbonic acid gas is broken up, and the carbon contained in the gas is fixed, combining with the elements of water in the presence of mineral matters brought up from the soil in the sap. If the foliage of a plant, therefore, be reduced by insect damage or injured by parasitic fungi, or otherwise, it obviously must affect the plant injuriously, and it truly does. It interferes with the proper nourishment of all parts of the plant, and a starved plant is no more in working condition than a starved animal.

We commonly take less notice however of injuries to the foliage, unless very pronouced, than of injuries to the fruit, for the reason that we do not market foliage, while we do fruit—and the price it brings depends upon its freedom from blemishes of all kinds. Knotty, wormy fruit, spotted and cracked by scab, is not tempting to the buyer.

The injury in the second case is visible, tangible and measureable—while effects of injuries to the foliage upon the power of plants to produce fruits are more difficult to appreciate. They are nevertheless serious.

Intelligent fruit growers realize the importance of preventing both kinds of injury to the fullest extent possible. They are in the business for the best results and the good grower is never satisfied with meager results when better are attainable, especially at only a slight cost or with a little additional timely effort. We cannot expect good fruit from ''dyspeptic, consumptive'' plants. Such plants do often make remarkable efforts to bear fruit and keep up their record for work, but the strain is so great that they sometimes die outright, or are so much weakened that they gradually collapse later unless they receive aid in time to save them. The real orchardist derives a part of his satisfaction from the love of the work of caring for his trees and takes the same pride in well fed, slick looking trees that a good horse-man takes in maintaining his blooded animals in the very ''pink of condition.''

Happily there is more than sentiment in the love of our calling. There is profit and success and the respect that the world always pays to success in any line of human endeavor. Sometimes success is purchased at a great price, even with life itself. Such a sacrifice is not necessary in fruit growing. We can by good care, spraying, etc., be successful at a cost of three to four cents a tree and render 95 per cent of the fruit of a large apple tree perfect, while also protecting the foliage and putting our trees in a large measure in condition for the production of the next year's crop. The work, however, must be done understandingly as to the objects to be attained and the means for bringing about the results desired. If the work be undertaken in such a manner there will ordinarily need be no fear as to the results. The work may be undertaken confidently. It may be undertaken with as much confidence as one has in insuring his house—indeed, as sometimes remarked, it is insurance. If the work be entered upon understandingly there will be no trouble about the details being carried out correctly. The work will be thorough. It will be timely—it will be with the right material and with the most efficient machinery. The factors which render spraying necessary in fruit growing, are of two general kinds, insects and fungi.

INSECTS AS CROP PESTS.

Insects are familiar creatures in the form of flies, June-bugs, wasps, candle-moths, etc. They are for the most part small creatures, having, as adults, six legs as a common characteristic. Usually they have wings, mostly two pairs, sometimes only one pair, and again are without wings, even as adults. In their life history they for the most part go through three or four distinct phases or stages of existence, there are (1) the egg stage; (2) the larval or worm stage; (3) the pupal or cocoon stage, and (4) the adult stage. Such are the stages passed through by a butterfly. A smaller number of insects pass through only three stages. The common squash bug is an example. What is known as the *nymph* stage here takes the place of the second and third stages mentioned above. A few insects hatch from the egg and do not have to pass through any marked stages in development. They simply grow. Vast numbers of insects are useful to man. Many of them render service by preying upon their fellows of other kinds, or lead parasitic lives.

There are great numbers however, which happen to have a taste for the same vegetables and fruits that man is fond of. In their view of things man must be a terrible enemy. From our point of view such insects are terrible enemies—pests. Insects may work damage to crops mainly in the larval (worm) stage, or as nymphs, or both in these stages and as adults. For the purposes of making warfare upon them insects may be divided into two types, according to the structure of their mouth parts, or feeding habits; namely, sucking insects and chewing insects. The former have a proboscis like the mosquito and live on liquid foods; example, the squash bug. The others take a more substantial diet and live upon the vegetable tissues which they bite off or chew off. It is important to know the habits of insects or something about them in order to fight them successfully as pests. It is of much importance to know the food habits just mentioned, since chewing insects, like the potato beetle are readily destroyed by poisoning their food. Sucking insects, on the contrary, are not affected by poison placed upon the foliage or other parts of plants, but are often susceptible to contact poison, in some instances to fumigants and trap methods. The latter are much more difficult to control, as a rule, than the former. Arsenical poisons are the chief dependence in controlling the first class—Paris green, arsenate of lead are the forms most largely used.

Kerosene emulsion, or the mechanical mixture of kerosene and water are the most generally efficient and cheapest remedies against the latter, but various other substances and methods are made use of in special cases.

FUNGI IN THEIR RELATION TO PLANT DISEASES.

Fungi are representations of a low type of plant life, which are very different in appearance and character from the ordinary plant. They do not produce flowers like those of the higher plants although they produce parts which answer the same purpose, that of reproduction, and in a very efficient way. Many of the representatives of this division of plant life are minute and microscopic in character, and the largest, or the reproductive phases of them, are not of very great bulk except as compared with the smaller types below them. The plant body consists of a minute whitish, branching cobweb-like thread, which in the process of growth under favorable conditions in some instances, forms a felt-like mass through the great multiplication and interlacing of the minute threads. The reproductive bodies variously borne are extremely minute and capable of floating in the air like particles of dust. Hence the facility with which these plants may spread from plant to place or plant to plant or leaf to leaf, unaided except by currents of air. The brown powder in puff-balls and the black powder of corn-smut and oat-smut, are familiar. This powder in each instance represents so many thousands or hundreds of thousands of the "spores," or reproductive bodies of these fungi. Some fungi do not usually produce spores but spread through the soil, or otherwise, by vegetative parts. Fungi are destitute of the green coloring matter found in nearly all the higher plants. On this account fungi cannot live like green plants on the mineral elements found in the soil, but are dependent for their food directly, or indirectly upon the "higher" green plant life. They are of two general types as to their habits of life; namely, (1) saprophytes, or those which live upon the decaying or dead organic matter—plant or animal remains; (2) parasites, or those which live at the expense of the plants or animals they infest.

What is called disease is often simply an unhealthy or dying condition of organisms or their organs, resulting from the presence in the tissues of parasitic fungi. The organism supporting the parasite being spoken of in such a case as the "host." In other cases the condition is simply physiological, or the result of mechanical injuries. In some fungi the life cycle, or course of development, is comparatively simple. In others, it is rather complex, consisting of several phases so different as to conceal the identity of the fungus, except to the trained investigator. Of the second type, some are superficial upon the tissues they infest. Others are internal parasites, gaining access readily through the breathing pores (stomata) upon the leaves and young parts of their host plant, but the fungal thread may even enter the tissues by an opening which it bores for itself through the epidermis. When once inside the tissues of the host these fungi are beyond the reach of remedies, since any remedy of sufficient strength to destroy the parasite would destroy the tissues of the host when externally applied—and internal diffusive remedies in the case of plants are out of the question. In all cases treatment must be prophylactic or preventive.

This consists in the use of fungicidal sprays for covering the exposed parts of the plants—thus destroying the fungus spores which may chance to lodge upon the plants before they have germinated and invaded the tissues. Again, by destroying infected materials we may prevent the development and dissemination of the spores. It is readily seen therefore that to be effective the spray must completely cover the exposed parts of the plant to be protected, and hence the necessity of the fine misty spray—not to mention economy of materials.

Apple scab, apple rust, bitter rot, peach leaf-curl, brown rot of the peach and plum, potato blight, corn-smut, are more or less familiar examples of fungus diseases in fruits, garden and farm crops.

It might seem that such minute reproductive bodies as the "spores" of fungi would stand an extremely poor chance in the struggle for existence going on incessantly in the plant and animal world—but the cultivator knows to his sorrow that such is not the case. These minute forms of life are endowed for their special kind of existence, and have abundant power to take care of themselves. They require, however, like ordinary plants, certain conditions for their development, as regards moisture, temperature, etc.—When such are present certain forms like scab and bitter rot of the apple, are likely to cause great damage. Some seasons fungi are very troublesome and are kept under control only through tireless vigilance. Again, the season is not favorable to these forms and in consequence damage may be very slight, or none, even without spraying or other precautions.

We have no means, however, of foretelling these conditions, so it is wisest to spray to be on the safe side. In instances when a particular disease has been serious previously, or the year before, as in the case of the apple scab fungus, spraying will be of benefit to the trees and help to produce the next crop, even if there is no crop on hand to recommend the spraying.

We have as efficient means of fighting fungi as we have for fighting chewing insects in the form of the fungicide known as bluestone or copper sulphate. Very small percentages of this salt dissolved in water are sufficient when applied, to prevent the germination of the spores of most fungi, while one part of the copper salt in 200 parts of water is abundantly sufficient to destroy life in the spores of any of the troublesome forms which afflict plants.

This substance in the strength mentioned (1 pound to 25 gallons of water) may be sprayed upon dormant trees, without injury to the trees, and is a valuable and important part of regular spraying. But this spray would destroy the foliage of plants in active growth. For spraying these the copper solution is made much stronger, but is mixed with a thin milk of lime. The result is the light blue liquid known as the Bordeaux mixture. In this the caustic properties of the copper salt are neutralized by the lime, when used in the proportions called for in the formula of Bordeaux mixture. The result is a harmless liquid as far as its application to the foliage of crops is concerned, but a powerful fungicide.

Happily it is possible to mix the common arsenicals with Bordeaux—in the same proportions we would use in mixing them with water. This results in a combined insecticide and fungicide which is often desirable and economical, in that it saves the labor and expense of applying each separately. It is nearly always desirable to use the combined spray. Either Paris green or arsenate of lead may be mixed with the Bordeaux.

The grower should adhere in practice to the methods which are well established. In case of newer things or methods it is well enough to try them, but only on a limited scale until their merits are fully known. Many growers, in spite of warnings, lost heavily by abandoning liquid sprays, for the trap-lantern of recent memory, which proved a total failure as far as apple insects and fungus diseases are concerned.

In spraying the grower must be on time. It is not a practice admitting of delays. When the time comes for a treatment, be ready, and let nothing interfere. Next be thorough—next be sure that the materials are pure. Lastly, see that the liquids are kept constantly agitated by some adequate appliance in the tank or barrel. A number of samples of paris green collected among growers and examined at this station showed more or less foreign substances, or a low standard of purity in all but three—and some of the samples were very greatly adulterated.

A general rule is never to spray plants in bloom.

SPRAYING APPLES.

Three to four sprayings yearly will commonly protect apple orchards against the common fungus diseases and insect pests, such as coddling-moth, bud-moth, curculio, tent caterpillar, canker worm, and the fungus diseases scab, and sooty blotch. In case bitter-rot appears, which is liable to occur any time after July, two or three extra spraying will be necessary.—Borers, scale, aphids, etc., require other treatment.

GENERAL TREATMENT.

First spraying. Before buds swell; copper sulphate solution. For scab, bitter-rot and black-rot.

Second spraying. As buds unfold or show green tips. Bordeaux and paris green or arsenate of lead. For scab and bud-moth.

Third spraying. Immediately after blossoms have fallen. Same material as second spraying. For codlin-moth, curculio, canker worm, tent caterpillar, scab, sooty blotch.

Fourth spraying. Seven to ten days later. Materials as in last spray. For codlin-moth, scab, sooty blotch.

From two to four additional sprayings from July will be required if bitter-rot makes its appearance. See bitter-rot below.

INSECTS.

Bud moth. The small caterpillar feeds upon the tender leaves of the opening buds. Remedy: Paris green or arsenate of lead as soon as buds show green.

Codlin-moth or Apple-worm. The pinkish larvæ bore into the apples and work in or around the core. Affect from 25 to 70 per cent of the apples, mostly enter the blossom end of the apple. Remedy: arsenate of lead or paris green.

Curculio. The adult is a snout beetle causing the so-called "sting" of the apple, grub tunnels into the apple. Remedy: Arsenical spray as above.

Canker Worm, Loop Worm or Measuring Worm. Spins a thread by which it hangs from the leaves when disturbed. Feed upon the foliage. Remedy: arsenical spray, sticky bands or tree tangle-foot, applied in a band around trunk in May to prevent the canker worm crawling up.

Tent Caterpillar. Makes tents upon branches, feed upon foliage, appearing in May. Remedy: Collect egg masses in winter, crush or burn nests. Spray with arsenical solution.

Fall Web-Worm. Cut off and crush nests. Arsenical spray.

Maggot. Railroad maggot; tunnels about in the fruit. Remedy: Hogs and sheep where admissible. Destroy infested fruit.

San Jose Scale. Ashy gray, small flat scales of circular outline, adhering closely to the bark. Remedy: 25 per cent mechanical mixture of kerosene and water applied to dormant trees in winter. Pure kerosene applied in winter in form of fine spray, sufficient to moisten the bark. Lime, salt and sulphur spray in winter.

Oyster Shell Bark-louse. Elongated club-shaped scales, often thickly covering the bark of twigs. Winter spray of no value. Spray in spring when the young have hatched and are crawling about in May, with kerosene emulsion, one part to fifteen of water, or whale-oil soap one pound to seven gallons of water.

Woolly Aphis. Sucking insect. They live in bluish white tufts about wounds, or on water sprouts, etc. Affect roots, also causing warty roots. Take special pains to protect young trees; less serious on old trees. Spots on branches may be rubbed with brush and linseed oil containing a little kerosene. Apply strong powdered tobacco in a trench around the young tree at a rate of half pound to two or three pounds per tree, according to size of tree. Fill trench with soil.

Round-headed Borer. Works in stem at surface of the ground. Carbon bisulphid at rate of a teaspoonful around young trees. See formulas. Care required. Insert copper wire in tunnel. Apply washes.

Flat-headed Borer. Bores in branches and on stem, commonly in connection with sun-scald, old cankers and in weak trees or parts. Avoid by maintaining vigor of trees. Insert flexible wire in burrow. Inject in holes a few drops of kerosene by means of a medicine dropper or oil can, or carbon bisulphide and plug holes with grafting wax.

FUNGUS DISEASES.

Scab. Causes superficial, scabby spots on fruit. Badly infested fruit misshapen and liable to crack. Causes smoky patches and later brown spots on leaves. Sometimes affects twigs. Favored by cool, moist, spring weather. Remedy: Copper sulphate solution on dormant trees. Bordeaux mixture as buds swell and after blossoms fall. If conditions favor the fungus repeat last spray in seven to ten days.

Sooty Blotch. Round colonies of blackish superficial growth, forming sooty spots, spots often coalescent. Remedy: Bordeaux mixture after blossoms fall, repeated at intervals of ten days.

Pink Rot. First noticed at the station associated with scab spots, summer of 1904. Developed on fruit in orchard and was a very serious accompaniment of scab, causing the rotting of fruit. Prevented by treatment for scab.

Bitter-rot. Well known and very rapidly destructive disease, appearing during warm, moist conditions from July till close of season. Appears as sprinkling of small black specks on fruit which rapidly may advance in size, becoming depressed, rotten spots, dotted with minute black pustules. Forms cankers on the branches. Remedies: Thin tops and prune up thick-headed trees, especially those in low ground. Cut out cankered limbs in winter. Gather and destroy rotten fruit and mummied apples on trees. Spray with Bordeaux mixture with first appearance of specks on fruit. Repeat immediately in case of rain; otherwise in ten to fourteen days and at similar intervals if conditions continue to favor fungus. As the fruit reaches full size, substitute ammoniacal copper-carbonate solution for the Bordeaux mixture, or weak copper sulphate solution.

FORMULAS.

FUNGICIDES.

Bordeaux Mixture.

Copper sulphate	4 pounds.
Quick lime	4 pounds.
Water	40 to 50 gallons.

Dissolve the copper sulphate by suspending it in a gunny sack near the surface of the water to facilitate solution. Warm water hastens solution. Dissolve one pound of copper sulphate to each gallon of water. This forms a stock solution. To supply amount called for in the formula it is only necessary to dip out four gallons. Slack lime in a flat box one foot deep five feet long and three wide, or of other convenient dimensions, place 100 pounds of fresh or quick lime. Slack and spread out in uniform layer, cover with water. Keep covered with water till used. Mark off upon the sides of the box 25 equal sections. The lime between any two such marks if carefully taken out will represent four pounds, near enough for practical purposes. For mixing, three vessels or wooden tubs are needed; two holding equal amounts and a third holding as much as both the first. The last should be elevated where large orchards are to be sprayed so that the mixture may be run from this tank directly into the sprayer tank. The two smaller tanks should be above this one. As the lime liquid and copper solution are prepared they may then be run into the third vessel through a strainer simultaneously. This step is of much importance and greatly improves the resultant mixture in adhesiveness as well as otherwise. For large orchards the smaller tanks may be a little more than 100 gallon tanks; the larger a 200 gallon tank. As the smaller tanks hold each two barrels, place in one 16 pounds of the stock lime, add water and stir, fill tank with water. In the other tank, place 16 gallons of the stock copper sulphate solution, then fill the tank with water. Next run the thin lime and the diluted copper sulphate solution into the third vessel, through a strainer, simultaneously, stirring the combined liquid as aforesaid. The result is Bordeaux mixture and is ready to be run into the sprayer tank. Bordeaux should be made fresh as needed. Mixtures allowed to stand for some time deteriorate in value. A polished knife blade held in Bordeaux mixture a few moments should show no metallic copper on the blade if there is enough lime present in the liquid. This is a simple test. The ferrocyanide of potassium affords another means of determining whether the Bordeaux contains sufficient lime. Five cents worth of the ferrocyanide of potassium dissolved in the smallest amount of water which will complete solution. It is poison. For using the test, place in a shallow porcelain saucer a small amount of the Bordeaux. Pour into it a few drops of the ferrocyanide solution. The appearance of a deep brown color indicates the need of more lime in the Bordeaux. If the drop of the ferrocyanide does not change color enough lime is present.

For a combined fungicide and insecticide add paris green at the rate of four ounces for each 50 gallons of Bordeaux mixture, or arsenate of lead, three pounds. Make the paris green first into a paste, with a small amount of water, or moisten it with alcohol. It will then readily mix with water.

Copper Sulphate Solution.

Copper sulphate	1 pound.
Water	25 gallons.

Ready for use as soon as dissolved; to be used only on *dormant trees,* and before the buds have started growth. A solution of one pound to 200 to 400 gallons of water has been recommended as a cheap substitute for ammonia, copper-carbonate solution, for use on fruits or plants in leaf. It washes off readily.

Ammonia Copper Carbonate Solution.

Copper carbonate	6 ounces.
Strong ammonia (26 deg.)	3 pints.
Water, to make	50 gallons.

Moisten the copper carbonate with a little wood spirits or water, and make into a paste. Then dilute the ammonia by adding 20 pints of water and stir in the copper carbonate. When dissolved, add enough water to make 50 gallons. Washes off readily and is preferred for this reason to Bordeaux on fruits that are approaching maturity.

INSECTICIDES.

Paris Green.

Impure grades of this poison have been sold to a number of our growers in the past as indicated by samples examined at the station. Care, therefore, should be used to obtain a guaranteed pure grade of the poison. Applied alone in water to foliage is unsafe. To obviate the danger of scorching the foliage lime at the rate of two pounds for each pound of the paris green should be added to the spray mixture. First slack the lime with a little water. The particles of Paris green do not dissolve and tend to settle to the bottom in liquid. Hence the need of an agitator when using paris green in spray liquids. Paris green is used at the rate of 4 ounces to 50 gallons of water or Bordeaux mixture for application to apples. Stone fruits being sensitive admit only at half of this amount as a rule.

London Purple.

Used the same as Paris green and in the same proportion, but is not quite so safe. Increase lime one-third.

Arsenate of Lead.

This poison is in many respects superior to paris green for spraying purposes. The particles are entirely insoluble in water—are very fine, and remain in suspension better, and when applied adhere to foliage quite persistently. One thorough application after foliage is grown being considered enough for the season, by some. It does not injure the foliage and may be used freely without the precautions required in applying Paris green. It costs more than Paris green since more is necessary to a barrel of liquid; three pounds to a barrel of water is the usual amount used. It may be mixed with Bordeaux instead of with water. ''Disparene'' and other brands are to be had of dealers, but it may be more cheaply made than bought.

Acetate of lead (sugar of lead), 11 ounces.
Arsenate of soda, 4 ounces.

Dissolve the amount of soda in a half gallon of water and the acetate of lead in one gallon of water. Pour the first solution into the second and stir. This is diluted to 40 or 50 gallons with water and is ready for use.

Kerosene Emulsion.

Hard soap	one-half pound.
Boiling water	one gallon.
Kerosene	two gallons.

Use soft water. Heat soap till all is dissolved. While boiling hot remove from fire, add the kerosene and whip vigorously into a cream. Pumping up the liquid with a bucket pump and forcing it back, is an efficient method of emulsifying the material. This requires about ten minutes. Well made it should show no free oil when a drop is placed on clean glass. It must be used within a few hours, as the oil tends to separate. The cheapest and most satisfactory general insecticide. For scale insects it is used at the rate of one part in four of water on dormant plants. For plant lice (aphids) it is diluted more; one part in 15 to 20 of water, being strong enough for such insects. The strong solution would be unsafe except on dormant woody plants. The weaker solution may be freely used on plants in active growth. of all kinds.

The emulsion of kerosene and water by means of a special type of spray pump is now much used for scale insects on orchard trees. The pump admits of regulating the percentage of oil in the spray by a small device, but in spraying it is always well to let a sample settle to be sure that the proper percentage of oil is being fed. Twenty-five per cent of kerosene is used for winter spraying for San Jose scale.

Whale Oil Soap.

For scale (dormant plants.)

Soap	two pounds.
Hot water	one gallon.

For plant lice:

Soap	one pound.
Water	six to seven gallons.

Carbon Bisulphide.

This is an odorous volatile liquid. Gas, inflammable and explosive. Its volatility, the heaviness of the fumes and poisonous character to insects render it of use for special purposes. For peach borers and the round-head apple-tree borer, working at the base of the trunk in apples, it is useful and more satisfactory than wiring. Remove the soil with a hoe or spade around the base of the stem, leaving a shallow funnel-like cavity; pour a teaspoon to two teaspoonsful upon the soil in a circle six inches from the trunk, being careful not to get the liquid on the bark of roots or stems. Draw the earth removed quickly back in the form of a small mound; pack it down with the back of the spade. Ten to twenty minutes is sufficient to kill borers in their channels, when the base of the stem may be coated with some of the alkaline washes or a sticky substance like that of fly paper, to keep away borers. A preparation of this kind may be had on the market and has been found harmless in trial here.

PUMPS AND NOZZLES.

Numerous pumps are made for the special work of spraying. Much in spraying depends upon the use of a good pump. It should give great pressure, with the least expenditure of power in the case of the hand pumps. Cheap, small contrivances, which some are led to buy, only result in disgust. There is no use in making spraying harder work than it actually need be as a poor pump does. A good barrel pump is suited to about ten acres of orchard. The larger pumps can do more, while the power rigs, of which several are offered for sale by manufacturers, are large enough to take care of large orchards and in such orchards readily repay their cost. Hand pumps allow the pressure to vary. A careful set of men, however, will do good work with such a pump. But high pressure from 125 to 200 pounds to the square inch makes spraying more efficient and economical. This pressure can be maintained only with the larger, more powerful pumps, or those arranged for some other than hand power, such as the gasoline engine, of about two to three-horse power. The parts of a spray pump, in contact with the liquids, should be of brass or brass lined, as otherwise the liquids corrode the metal and ruin the parts, besides injury done the spraying liquid. There should always be an efficient agitator for the liquid, provided with the pump. Nozzles now mostly used are of the vermorel or eddy-chamber type. The Bordeaux and the large styles, known as the "Boss," the "Mystery," "The Friend," are in use. Bamboo extension-rods ten feet long are a necessary part of the outfit for orchard work. A platform or tower upon the spray rig is a necessity in some orchards where there are tall trees. At work one man occupies the tower, the other works on the ground. For addresses of spray pump manufacturers, consult the fruit and agricultural journals.

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AGRICULTURAL

EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

TWENTIETH ANNUAL REPORT

1907

Agricultural Experiment Station.

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BOARD OF CONTROL.

Committee on Agricultural Department, President of the University, Director of the Station.

STATION STAFF.

W. G. VINCENHELLER	DIRECTOR
R. R. DINWIDDIE	Pathologist and Bacteriologist
GEO. A. COLE	Professor of Agriculture
ERNEST WALKER	Horticulturist
JOHN H. NORTON	Chemist
V. A. HOOPER	Dairy Husbandry
C. F. ADAMS	Entomologist
W. LENTON	Veterinarian
C. P. NORGORD	Agriculturist
J. LEE HEWITT	Assistant Horticulturist in Charge
W. S. JACOBS	Assistant Agriculturist
R. J. NELSON	Field Agent
C. H. TOURGEE	Assistant Dairyman
EDITH GILLAM BLACK	Executive Clerk

Correspondents should notify the Director of any change of Post Office Address, error in Address, or failure or delay in receiving Bulletins.

W. G. VINCENHELLER, Director,
Fayetteville, Ark.

UNIVERSITY OF ILLINOIS
AGRICULTURE LIBRARY

ARKANSAS EXPERIMENT STATION,

Fayetteville, Ark., Dec. 1, 1907.

To His Excellency, JOHN S. LITTLE,
Governor of Arkansas:

Sir—

I have the honor to transmit to you herewith the Twentieth Annual Report of the Arkansas Agricultural Experiment Station.

Most respectfully,

W. G. Vincenheller,
Director.

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TWENTIETH ANNUAL REPORT

OF THE

Arkansas Agricultural Experiment Station

For the Year Ending June 30, 1907.

REPORT OF THE DIRECTOR.

The year of 1906-1907 has been the busiest and most effective of any in the history of the Station, partly due to the establishment of new departments which has furnished an opportunity to enlarge the usefulness of the Station, and extend its workings into fields heretofore unentered. As the work of the Station has been extended, interest and appreciation has increased accordingly throughout the State. A detailed account of the work of the different departments for the year ending June 30, '07, will be found elsewhere.

FINANCIAL CONDITION.

Previous to the year 1905 the sole revenue of the Station was the government Hatch fund of $15,000 annually, $1500 from the Morrill fund, and a thousand or twelve hundred from the sale of farm products. Naturally, work in every line was restricted because of lack of funds, proper buildings, and equipment. However, even under these adverse conditions commendable progress was made each year, and interest and appreciation aroused among the farmers of the State to the extent that their influence had largely to do with the State making its first much needed appropriation. This appropriation carried $35,500, which embraced salaries for additional men, maintenance, student labor, dairy and live stock husbandry, and $17,500 of which was for a new agricultural and dairy building. For sub-stations $3,000 was appropriated.

In 1906 the Adams Act passed the United States Congress, which gave to the Stations $5,000 for that fiscal year, with an increase of $2,000 per year until it amounts to $15,000 annually.

The rice experiment at Lonoke for the past year fully confirms previous reports that the prairie section of that country is adapted to the successful and profitable growing of rice. The success of this industry has enhanced land values in that section many fold, and attracted immigration from a wide section of the United States. We now need only to continue to encourage the industry and inaugurate a system of drainage to complete the work. This station, as well as the sub-stations at Danville and Experiment, are reported on more fully elsewhere in this report by the Field agent in charge. The importance and success of these three sub-stations are evidenced by the recent State appropriation increasing these stations to one in each Congressional District, with a fund for maintenance of each of $1500.

In the department of Bacteriology and Pathology which in the present year includes, besides research work proper to that department (under the Adams appropriation), a supervision of the section of Veterinary Science, two lines of co-operative work with the Federal Department of Agriculture are being carried on. These are described in the report of that department. It is expected that the work of tick eradication, by placing the raising of cattle on the farm on a more profitable basis will ultimately prove of benefit to all kinds of farming, and fruit raising as well. As a result of this year's work four counties have been offered freedom from government quarantine and one placed under modified quarantine. The meagre appropriation allowed by the State for this work is now practically exhausted, and further prosecution of the work for the next year must be done by voluntary contributions from the counties or by the Federal Government alone. There is an urgent need for further State funds for this line of work at the earliest possible time.

Veterinary inspection of contagious stock diseases throughout the State is an important part of the work of this department, which has now been placed on a better footing by the recent enactment of adequate Live Stock Sanitary laws.

The research work of the department of Animal Pathology and Bacteriology includes investigations of the methods by which this practical work can be most effectively carried on.

In the Agricultural department important work in plant breeding is being carried on. We hope from these experiments that within a few years we will be able to supply the farmers of the State with pure bred seed in corn, cotton, etc. When this is accomplished a large saving will result to the farmers, as well as a protection against impure, unreliable and contaminated seed.

In the Horticultural department, experiments in several lines of orcharding, an improvement of worn lands particularly, have demonstrated to our fruit growers the value, importance and necessity of proper spraying, pruning, thorough cultivation and fertilizing.

GROWTH OF CORRESPONDENCE AND MAILING LIST.

That the work of the Station is being appreciated more and more by the farmers of the State is evidenced by the large increase in correspondence and the daily requests for bulletins. The demand has increased almost beyond our inability to supply without additional funds for printing. Not only do requests come from this State, but from all over the United States and foreign countries. Permission has been asked by several institutions to use certain of our bulletins as text-books in their agricultural and horticultural work. So much time is demanded for mailing out the bulletins requested that it has become necessary to employ an extra clerk in this capacity a portion of the time. The following is a list of the publications during the year. A complete list of all bulletins to June 30, 1907, will be found elsewhere in this report.

BULLETINS PUBLISHED FOR THE YEAR ENDING JUNE 30, '07.

Bulletin No. 92, Some Insects of Orchards and Other Fruits, by C. F. Adams.

Bulletin No. 93, Cattle Tick Eradication in Northwest Arkansas, by W. G. Vincenheller, Director.

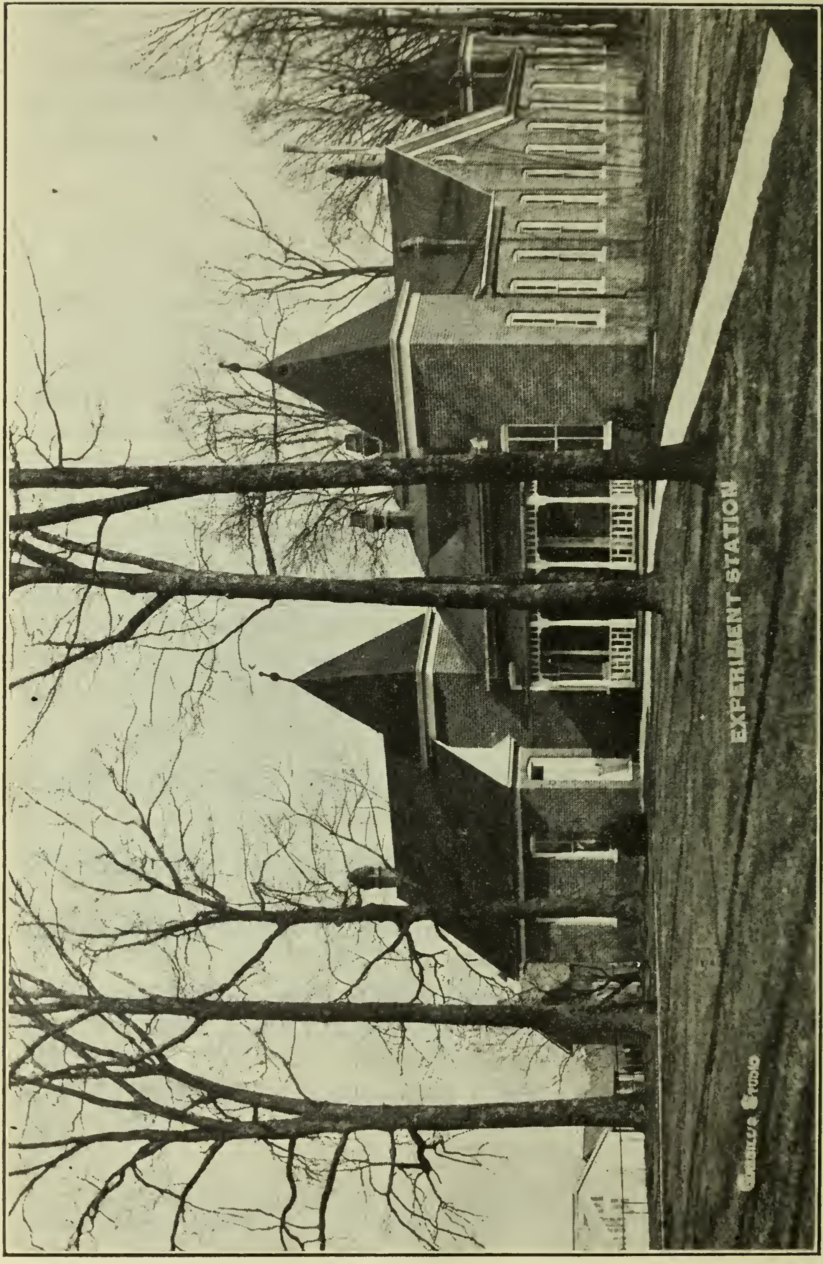
Bulletin No. 94, Rice Culture, by R. J. Nelson, Field Agent.

Bulletin No. 95, Notes on Spraying and Suggestions for Combatting Crop Pests. By Ernest Walker.

Report—Nineteenth, July 1, 1905, to July 1, 1906, by W. G. Vincenheller, Director.

CHANGES AND ADDITIONS TO STATION STAFF.

The following changes and additions to the staff have occurred during the year covered by this report:



Old Experiment Station, now Departments of Pathology and Chemistry.

In June, 1907, R. W. Wade, Agriculturist, resigned to accept a like position in the Agricultural College of Ontario, and C. P. Norgord, a graduate of the Wisconsin Agricultural College, was elected to fill the vacancy. Ernest Walker, Horticulturist, was promoted to research work under the Adams fund, and J. Lee Hewitt, Assistant Horticulturist, was re-elected as Assistant Horticulturist, in charge. R. R. Dinwiddie, Pathologist, was promoted to work exclusively under the Adams fund, and W. Lenton, Assistant Veterinarian, was re-elected Veterinarian. A. K. Short was appointed assistant to Dr. Dinwiddie vice J. F. Stanford, who returned to Chicago to finish his course in Veterinary Science.

In September, 1906, C. H. Tourgee, a graduate of the Iowa Agricultural College, was appointed assistant Dairy Husbandman. In June, 1907, W. S. Jacobs, a graduate of the Ontario Agricultural College, was elected to the position of Assistant Agriculturist.

ADAMS ACT.

The Adams Act, passed by United States Congress, 1906, provides an additional fund which will ultimately be increased to $15,000. This fund is to be expended strictly in research and original investigation. To meet this condition a re-arrangement of the work and duties of some of the departments has become necessary in order that this appropriation may be available. Those of most experience and ability, so far as the fund applies, have undertaken work under this fund and have outlined and initiated investigations which have been approved by the Department of Agriculture, Washington, D. C. Further reference to this work is made by the heads of departments in their respective reports.

COLLEGIATE INSTRUCTION.

A systematic course of collegiate instruction in the agricultural sciences has been organized and continuously carried on during the year in the departments of Agriculture, Horticulture, Entomology and Veterinary Science. The attendance and interest in these classes warrants the belief that this school will soon attain the prominence and appreciation which its importance demands.

Looking West Across Experiment Station Grounds to Infirmary.

SHORT COURSE.

The Short Course of practical instruction for farmers conducted during the past winter was a successful and gratifying beginning in this line. Twenty-five farmers availed themselves of this course and were enthusiastic over the information obtained, and the manner of instruction. Some of them came from the extreme borders of the State, and each predicted a large and increased attendance from their several localities for the next year.

EXTENSION WORK.

In accordance with advices from Washington we have under consideration the methods of extension work other than institutes, in the teaching of agriculture, which may be applicable to our conditions in this State. The State appropriation of $3000 for institute work will be devoted exclusively to travel. The work will be done largely by the Station Staff, and we hope to be able to cover all the State if possible. With the farmers this is a most popular feature, and it is gratifying to the Station to be able to meet the many and constant demands upon it in this line of work.

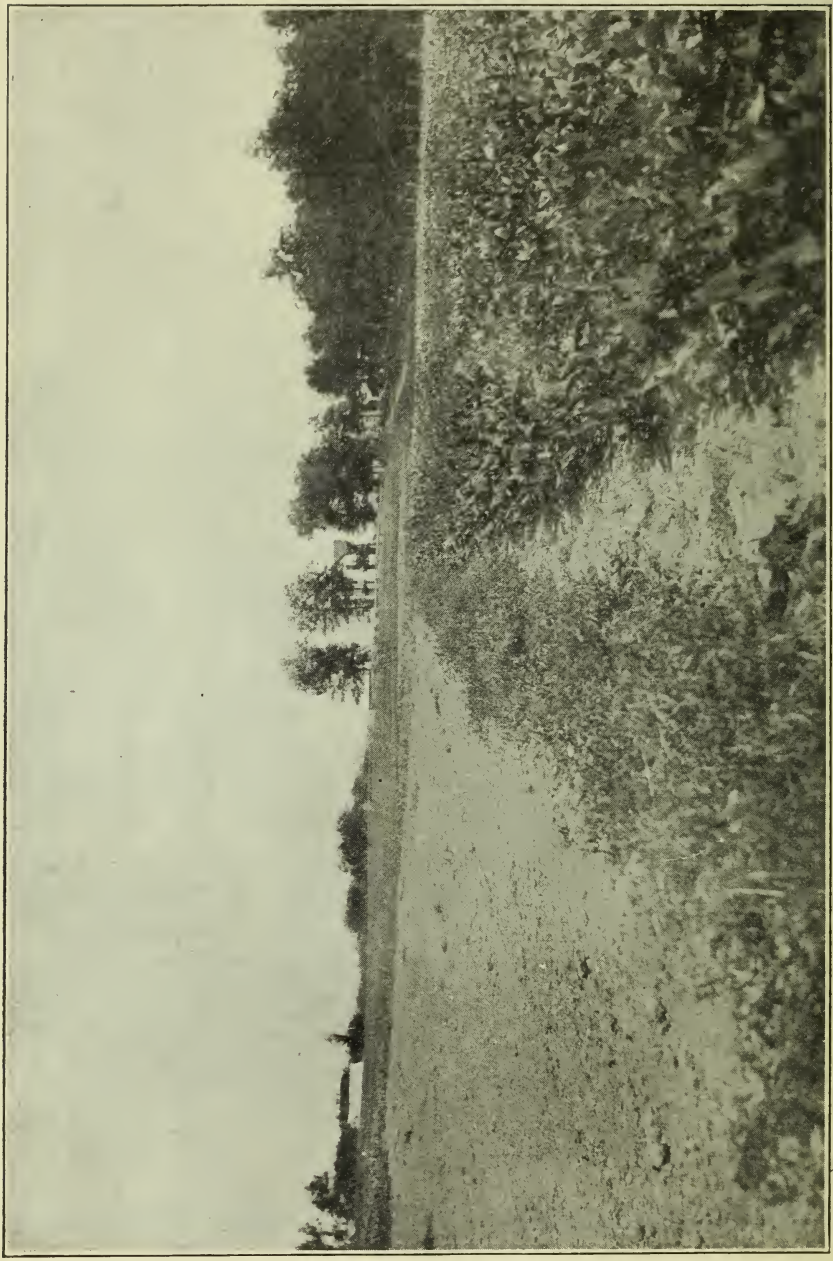
NEEDS OF THE STATION.

The greatest need of the Station at the present time is more land. Owing to the enlarged departments and increase in animal husbandry, swine breeding, stock feeding, poultry-raising, etc., we were compelled to secure additional land. An appropriation was asked from the State with which to purchase more land, but leasing was advocated rather than buying at this time. Eighty acres has been leased for a term of six years adjacent to 120 acres owned by the University.

There is also urgent need of further State funds with which to carry on the work of tick eradication.

Respectfully submitted,

W. G. VINCENHELLER,
Director.



A Portion of Experiment Station Farm.

REPORT OF THE AGRICULTURAL DEPARTMENT.

W. G. Vincenheller, Director.

Sir:—I have the honor to submit herewith report of the Agricultural Department for the fiscal year ending June 30, 1907:

Instruction in Animal Husbandry. This course consists of the study of breeds of farm animals, principles of breeding and feeding, and practical work in stock judging;

Experiments with field crops with varieties of corn, cowpeas, grains, etc., methods of planting, cultivation and harvesting;

Experiments with live stock—breeding and feeding of swine for market;

Poultry—breeding for eggs and meat production—methods of feeding.

Correspondence of the Department has been increasing rapidly and is worthy of mention as an indication of the interest and confidence of the farmers in the work. Much time and attention is given to answering their inquiries in a careful and explicit manner.

Respectfully submitted,

R. W. WADE,
Agriculturist.

REPORT OF THE PROFESSOR OF AGRICULTURE.

W. G. Vincenheller, Director.

Sir:—The work for the year 1906-07 has been an improvement over all other years, for the reason of new buildings and better equipment. There is an increase in the enrollment over former years—256 being enrolled in the different classes. Forty-five of this number are taking four years' course leading to the B. S. A. degree—ten the two-year course—twenty-four the short winter course, and the remainder electing two to five hours.

Our work in this Department would be improved if we had a soils laboratory fully equipped, and more cases for the storing of samples of seeds and forage crops for instructional purposes.

Respectfully submitted,

G. A. COLE,
Professor of Agriculture.

Fig. 1. Poultry Yards at the Ark. Agr. Exp. Station.

REPORT OF THE HORTICULTURAL DEPARTMENT.

W. G. Vincenheller, Director.

Sir:—The work of this Department covers instruction in the University and Station Experiment work under both the Hatch and Adams fund.

In the University work classes have continued to grow. We now have class rooms and space for laboratory work. Two forcing-houses for warm-house and cool-house crops, to give practical instruction in the forcing of vegetables and flowers, is much needed.

As to Experiment Station work in horticulture, bulletin No. 95 was issued this spring. It is the second report along the lines discussed in bulletin No. 91, and gives further results in the renovation of a run-down apple orchard, together with fairly complete instructions upon the subject of spraying for the control of fungus diseases and insects. Both these bulletins have met with a hearty reception among the fruit-growers and undoubtedly have had a marked influence in stimulating interest in the better care of orchards.

Work is in progress upon a method with Irish potatoes; upon asparagus, rhubarb and strawberries. A number of Hungarian varieties of apples are being tested in cooperation with the U. S. Department of Agriculture, as well as tests with some other foreign plants.

Under the Adams fund work has been started along the following lines:

1. A physiological study of the effects of pruning upon the tree and fruit of the apple;
2. Tentatively, upon sap pressure in relation to vernation;
3. Also bleeding in the apple tree, likewise tentatively;
4. Twig blight of the apple. This line is being prosecuted directly by Mr. J. L. Hewitt, Assistant Horticulturist.
5. This Department is cooperating with the Chemist in a study of the chemical elements used by various fruiting plants, as represented in the annual growth and crops.

Respectfully submitted,

ERNEST WALKER,

Prof. of Hort. and Horticulturist of the Expt. Sta.

REPORT OF THE DEPARTMENT OF BACTERIOLOGY AND ANIMAL DISEASES.

W. G. Vincenheller, Director.

Sir:—In this Department we have been engaged during the year ending June 30, 1907, in conducting the following lines of investigation:

1. In the investigation of the mode of spread of charbon in this State; tests of the value of vaccination and commercial vaccines against this disease of stock, and experiments on new methods of vaccination;
2. In investigating the conditions under which the cattle tick has become prevalent in North Arkansas; experiments on the mode of transmission of tick fever, and experimental work to discover certain points in the local life history of the cattle tick with the view of furthering the work of tick eradication in the northern counties of this State;
3. A continuation of our work on the toxic or poisonous action of cotton-seed meal on live stock, especially hogs;

The State veterinary, or inspection work, has now been placed on a much better footing by the passage of our new Live Stock Sanitary Act. This, and the active work in tick eradication, in cooperation with the Bureau of Animal Industry, I have left mostly to Dr. W. Lenton, and would recommend that he be given full charge of this line of work as Veterinarian to the Experiment Station, which would leave me the time for purely investigation work under the Adams' appropriation.

Respectfully submitted,

R. R. DINWIDDIE,
Bacteriologist and Pathologist.

REPORT OF THE VETERINARY DEPARTMENT.

Director W. G. Vincenheller.

Sir:—I beg to submit the following report of the Veterinary Department for the year ending June 30, 1907:

Since last July I have been employed principally on the work of live stock sanitation—investigating and diagnosing contagious dis-seases, in different parts of the State, and in locating areas infected with the boophilus annulatus tick, the agent of conveyance of the tick (or "Texas") fever germ.

Since classes began last September I have, in addition, had a class of students for instruction in Veterinary Science twice a week and two hours clinical work on Saturday mornings.

Experiments have been and are still being conducted with a view to determining suitable purgatives and anthelmintics for hogs.

Respectfully submitted,

W. LENTON,
In charge of Veterinary work.

REPORT OF DEPARTMENT OF ENTOMOLOGY.

W. G. Vincenheller, Director.

Sir:—Herewith is submitted statement of the department of Entomology for the fiscal year ending June 30, 1907:

The investigation of the life history and embryology of the Cattle Tick is being carried on under the Adams' fund, as was originally planned. As the points of embryology are most important, more time is being given to that phase of the subject.

The correspondence of the Department has been very much increased during the past year. Many inquiries, from many parts of the State concerning injurious insects, have been received, and a better knowledge of the present condition has been obtained. In this way notice has come to the Department of the occurrence of many injurious insects which should receive more attention.

This Department submitted for publication Bulletin No. 92 on "Some Insects of the Orchard and Other Fruits." In this bulletin detailed descriptions of some of our most injurious insects infesting the fruit-growers' districts are given, including remedies and suggestions for prevention.

As during last year, instruction was given in General Entomology and Advanced Economic Entomology. The class in the former continued through the first term only; that in the latter throughout the year.

Through the aid of student labor the effort to build up a general collection was continued. Such work requires much time, and above all competent assistance. Much good material, though, has been gathered together, and after it is studied and arranged it will make a creditable showing. From the standpoint of Systematic Entomology Arkansas is a virgin field, and as Systematic Entomology is the foundation of all phases of the subject it is receiving its share of attention.

C. F. ADAMS,
Entomologist.

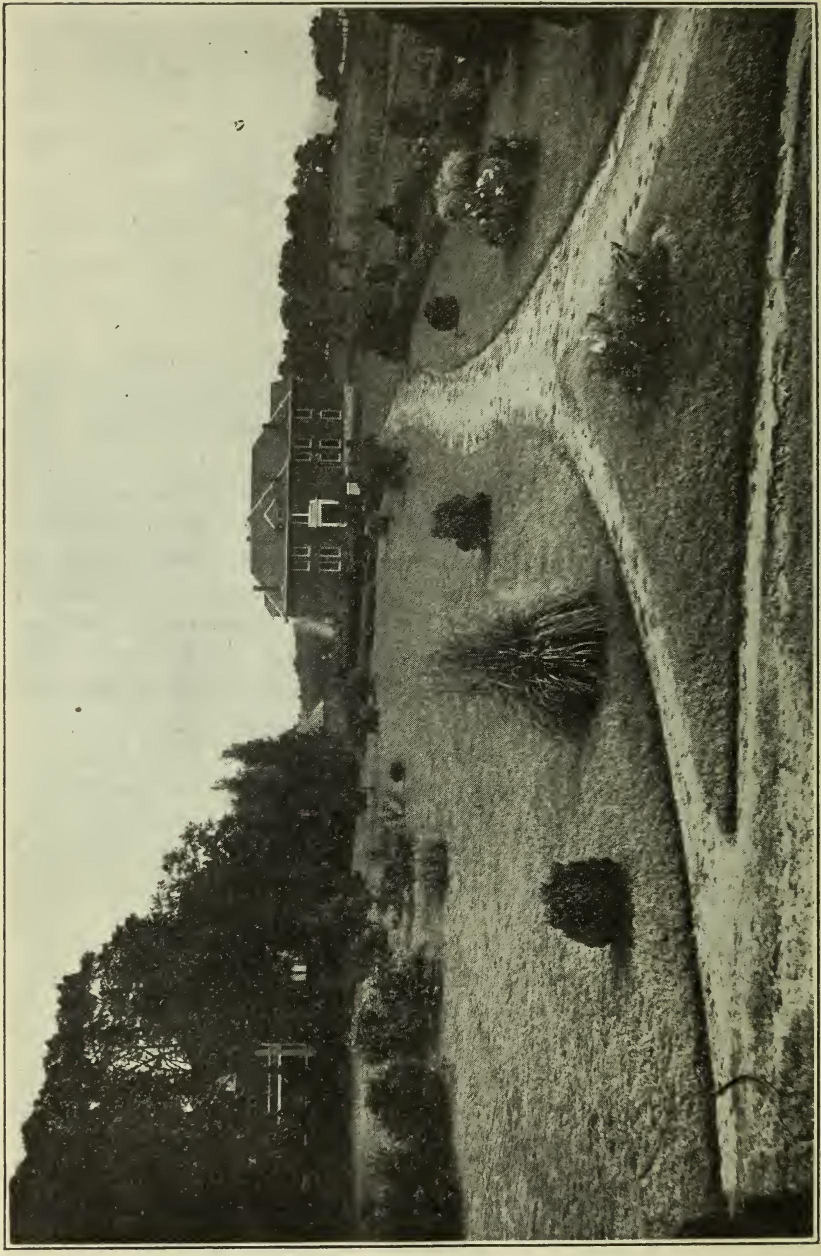
REPORT OF THE CHEMICAL DEPARTMENT.

W. G. Vincenheller, Director.

Sir:—I have pleasure in submitting the following report for the Department of Chemistry for the year ending June 30, 1907:

ROUTINE WORK.

This work consists in making analyses of soils, fertilizers, feeding stuffs and other agricultural products for other members of the staff and such samples as come from various citizens of the State. The records show that nine such samples have been analyzed in the past year, while a number of unimportant ones were analyzed without being recorded.



Looking South Across Experiment Station Grounds to Gray's Hall (New Boy's Dormitory).

WORK COMPLETED.

The determination of the losses from the soil by erosion and solution through the agency of drainage water, and the relation existing between rainfall and drainage water, has been completed.

INCOMPLETE WORK NOW IN PROGRESS.

The digestibility of forage crops of this State. Some nutrition investigations. The origin of the so-called "Prairie dog" mounds is in cooperation with the department of Geology. An experiment of determining the quantity and composition of the yearly growth, from planting to the final limit of usefulness, of two varieties of peaches, five of apples, two of grapes, one of blackberries, two of raspberries and four of strawberries is in cooperation with the department of Horticulture. The chemical study of twig blight is also in cooperation with the Department of Horticulture.

CONTEMPLATED NEW WORK.

In cooperation with the department of Pathology and Bacteriology it is proposed to determine the injurious compound or compounds which exist in cotton seed meal, and devise a commercial means of eliminating same.

Respectfully submitted,

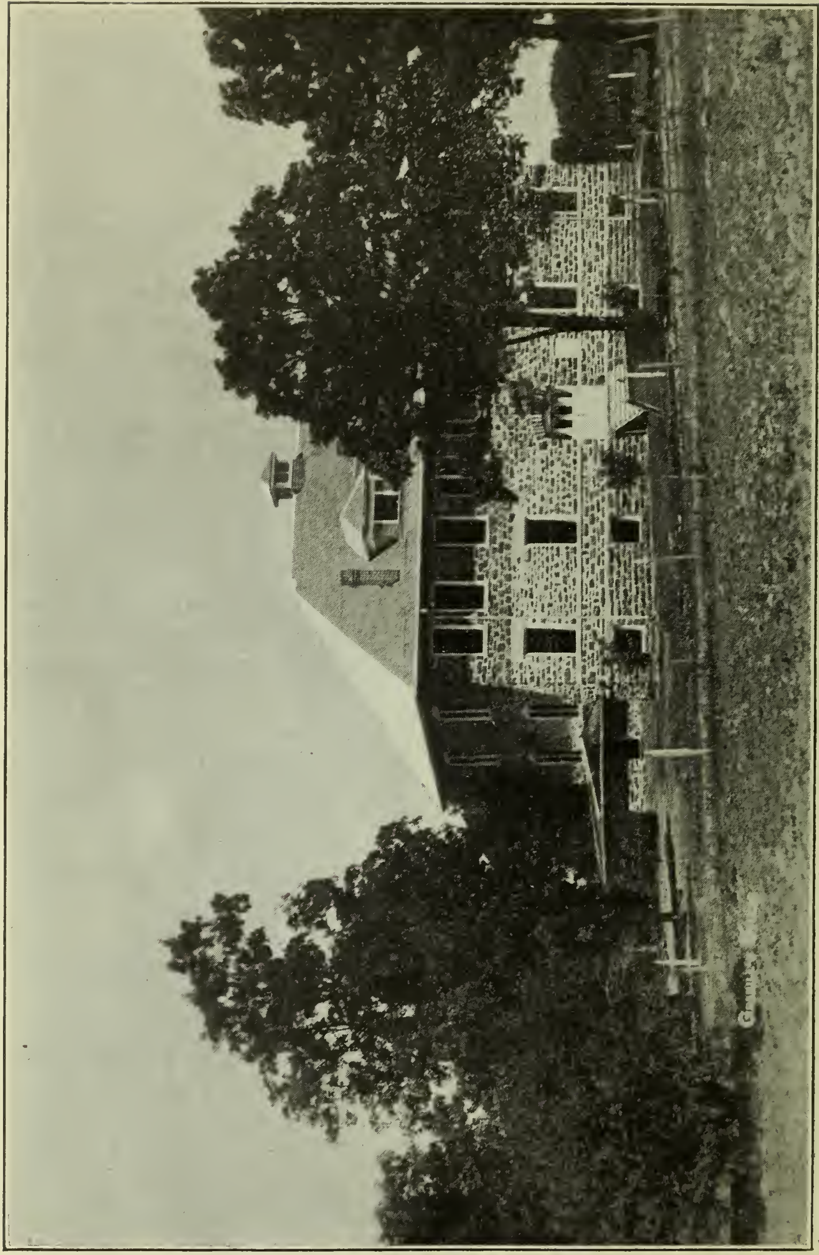
JOHN H. NORTON,
Chemist.

REPORT OF THE DEPARTMENT OF DAIRY HUSBANDRY.

W. G. Vincenheller, Director.

Dear Sir:—I herewith submit report of the Department of Dairy Husbandry for the fiscal year ending June 30, 1907:

During the summer of 1906, my time was largely devoted to installing the equipment in the new Dairy Building. The equipment and apparatus for class work was in readiness at the opening of the first term. The creamery commenced operations on the first day of October. During that month we received 6437 pounds of milk, for which we paid $108.64. During the past month we received 23,745 pounds of milk, for which we paid $356. This growth was brought about by our paying patrons fully 25% more money for their milk than they have heretofore obtained by selling butter.



Dairy Building.

To engage in experimental work in butter making we will require a daily supply of at least three and, better, five thousand pounds of milk. Dairying is a new feature of farm work in this section and it will take some time to work up this supply. During the past winter feeding experiments with corn silage, different kinds and amounts of hay, and concentrates, was carried on to a limited extent—as much so as our facilities would allow, and this will be continued during the ensuing two or three winters.

Experimental work in summer soiling crops was instituted during the summer of 1906. This will be continued for two years. The results from the past summer will give data from which the acreage, the quantity of seed to use, and the time to sow, can better be determined for the coming summer.

Throughout the year instruction was given to classes in the two and four year courses.

The following loans and donations have been made to this department by the manufacturers of dairy equipment:

D. H. Burrell & Co., Little Falls, N. Y.:	
1 No. 3, Simplex Churn	$150.00
1 Simplex Hand Separator	85.00
Creamery Package Mfg. Co., Kansas City, Mo.:	
1 20th Century Milk Heater	$100.00
1 Skim-milk Pasteurizer	35.00
1 300-gallon Milk Receiving Vat	80.00
1 Rotary Force Pump	32.00
1 Wizard Turbine Babcock Tester	35.00
1 Wisconsin Curd Test Outfit	15.00
The Delaval Separator Co., Chicago, Ill.:	
1 "Alpha" No. 1 Power Separator	$500.00
1 "Daisy" Hand Separator	85.00
Empire Separator Company, Bloomfield, N. J.:	
1 Empire Hand Separator	100.00
Iowa Sfparator Company, Waterloo, Iowa:	
1 Hand Separator	85.00
National Separator Company, Newark, N. J.:	
1 No. 12 National Cream Separator	85.00

SHARPLES SEPARATOR COMPANY, West Chester, Pa.:

1 No. 10 Turbine Sharples Separator	$225.00
1 No. 4 Sharples Hand Separator	85.00

SEARS, ROEBUCK & CO., Chicago, Ill.:

1 Economy Hand Separator	53.50

DONATIONS.

M. H. FAIRCHILDS & CO., Chicago, Ill.:

1 Keg Fairchilds' Dairy Powder	$ 8.10
1 5-lb. can Kno-germ	2.50
1-4 gross metal polish	5.40

H. B. FORD & CO., Wyandotte, Mich.:

1 Bbl. Wyandotte Cleaning Powder	8.00

JENSEN MFG. COMPANY, Topeka, Kans.:

1 Jensen Babcock Hand Tester	$ 12.00

VERMONT FARM MACHINE COMPANY, Bellows Falls, Vt.:

1 U. S. Hand Separator (loaned)	$ 85.00
4 Butter Carrier boxes	21.00
1 Davis Swing Churn	12.00
1 Babcock Hand Tester	8.00
1 Butter Printer	1.80

Respectfully submitted,
V. A. HOOPER,
Dairy Husbandman.
May 27, 1907.

SUB-STATIONS.

At Lonoke land was furnished for this station by Hon. W. P. Fletcher. Same was for five years or longer, without expense to the State or Experiment Station. This land was typical of the prairie sections of Arkansas, on which a rice plant had previously been established by the Arkansas Experiment Station in cooperation with the U. S. Dept. of Agriculture, Washington, D. C., a full report of which is embraced in bulletin 89 of this station. Report of the rice crop for 1906 is published in bulletin 91 of this station.

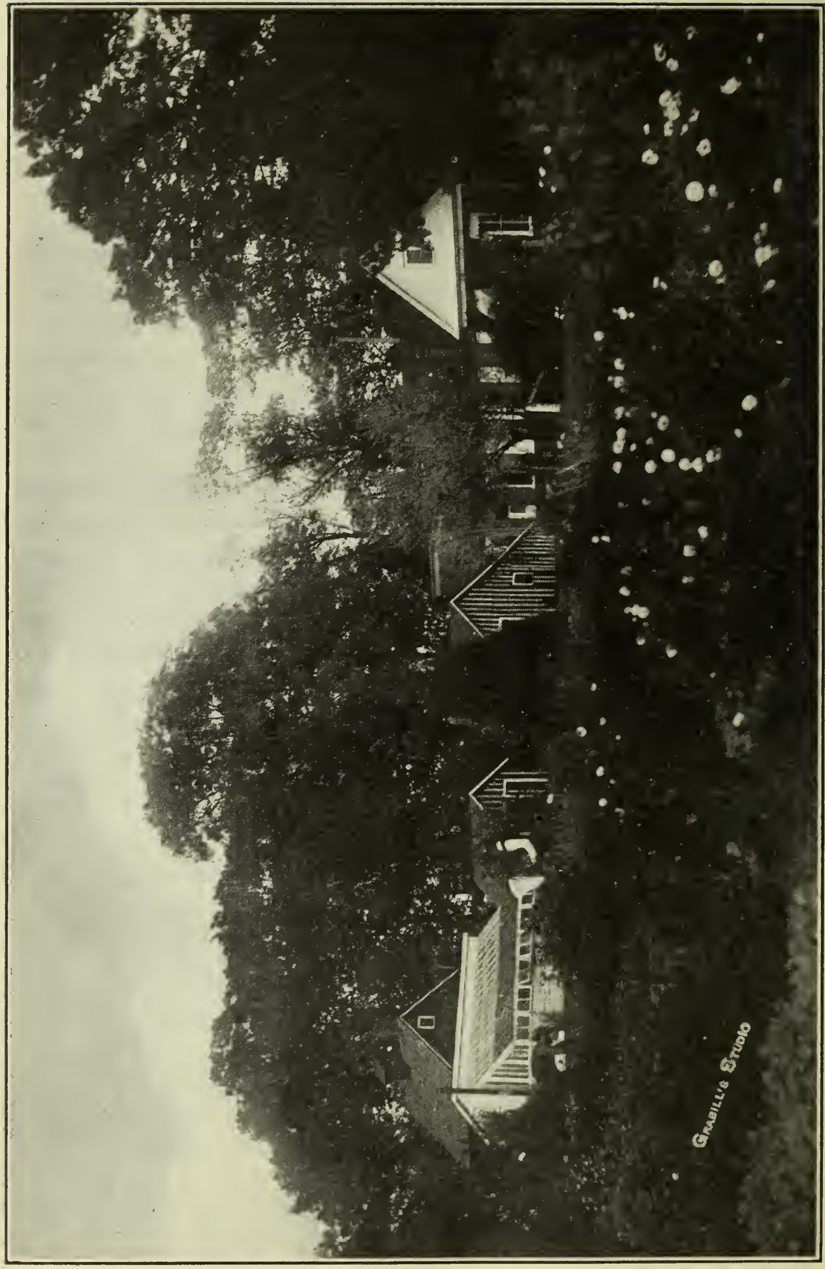
An experiment to determine the profitableness of truck-growing with rice-growing was carried on and proved that when a market could be had fall gardening would be a valuable side line. An orchard, consisting of apples, peaches, pears, plums and cherries was also planted at this sub-station and has made a splendid growth.

At Danville, Messrs. J. E. Chambers, J. N. Falls, John Lewis and other progressive citizens of Yell County, furnished twenty acres one mile from town as the central-west station. The soil was sandy loam, underlaid with red clay sub-soil, and had been in cultivation fifteen years or more, much of the time by renters, who paid no attention to the fertility of the soil. This land furnishes a splendid opportunity to show the results of rotation, fertilization and intensive farming on worn out soil. Seven varieties of corn, two of cotton, Louisiana sugar cane and cowpeas were grown. No recommendations can as yet be made on the varieties of corn and cotton. An orchard was also planted at this sub-station, same as at Lonoke, and has made a fair growth.

At Experiment land was donated by Mr. Geo. F. Jasper. Several varieties of corn were tested but not enough is known at present to recommend any one above the other. Seventy bushels of merchantable potatoes (Bliss Triumph) were grown at this station, dug June 13, and found a ready market in St. Louis at 90 cents per bushel. All vegetables grow well at this station, also watermelons. An orchard of the same varieties of fruit mentioned at Lonoke was planted at this station and is promising. The soil is a light sandy loam, underlaid by clay sub-soil. The general character of the soil was found to be similar to that of other portions of southern Arkansas.

Respectfully submitted,

R. J. NELSON,
Field Agent.



North View of Grounds West of Experiment Station.

LIST OF BULLETINS PUBLISHED BY THE ARKANSAS AGRICULTURAL EXPERIMENT STATION.

(Bulletins previous to No. 8 are omitted because entirely out of print at this station.)

*Bulletin No. 8, April 19, 1889, 8 pages. Spaying of Cattle.

*Bulletin No. 9, May, 1889, 12 pages. Cotton Seed Hulls for Fattening.

*Bulletin No. 10, June, 1889, 15 pages. Entomological Notes. By C. W. Woodsworth.

*Bulletin No. 11, September, 1889. Tests of Varieties of Strawberries and Wheat; Fertilizers on Oats.

*Bulletin No. 12, April, 1890, 12 pages. Influence of Spaying on Milk Production. By R. R. Dinwiddie.

*Bulletin No. 13, August, 1890, 8 pages. Strawberries. By J. McNeill.

*Bulletin No. 14, September, 1890, 14 pages. The Effects of the Arsenites upon Plants. C. W. Woodworth.

*Bulletin No. 15, December, 1890, 10 pages. New Insecticides for the Cotton Worm. By A. E. Menke and G. C. Davis.

*Bulletin No. 16, July, 1891, 15 pages. Ringworm. By R. R. Dinwiddie.

*Bulletin No. 17, October, 1891, 16 pages. Tests of Varieties of Fruit. By J. F. McKay.

*Bulletin No. 18, February, 1892, 16 pages. Some Cotton Experiments. By R. L. Bennett.

*Bulletin No. 19, May, 1892, 55 pages. Manures and Some Principles in Farm Manuring. By G. L. Teller.

*Bulletin No. 20, November 18, 1892, 11 pages. Animal Parasitism. By R. R. Dinwiddie.

*Bulletin No. 20, November, 1892, 17 pages. Texas Fever experiments. By R. R. Dinwiddie.

*Bulletin No. 21, December, 1892, 35-62 pages. Grapes and Apples. By J. T. Stinson.

*Bulletin No. 22, December 22, 1892, 67 pages. Varieties of Cantaloupes. By C. L. Newman.

*Bulletin No. 23, March, 1893, 87-107 pages. Experiments on Cotton. By R. L. Bennett.

*Bulletin No. 24, July, 1893, 122-144 pages. Fodder. Qualities Which Determine the Market Value of Hay. By G. L. Teller.

*Bulletin No. 25, December, 1893. Animal Pathology. By R. R. Dinwiddie.

*Bulletin No. 26, January, 1894, 37-44 pages. Horticulture. By J. T. Stinson.

Bulletin No. 27, March, 1904. Agriculture. Late Crops for Overflow Land. By R. L. Bennett.

Bulletin No. 28, June, 1894. Agriculture. Rye for Green Winter Feeding. By C.. L. Newman.

Bulletin No. 29, July, 1894. Agriculture. Wheat Experiments on Sandy Loam. Grass Experiments. By R. L. Bennett; Geo. B. Irby, Assistant.

*Bulletin No. 30, September, 1894. Stock Feeding. By G. L. Teller.

Bulletin No. 31, December, 1894. Agriculture. Fattening Mature Steers on Cotton-Seed and Cowpea Hay. By R. L. Bennett and G. B. Irby, Assistant.

Bulletin No. 32, December, 1894. Farm Drainage. By C. L. Newman.

Bulletin No. 33, January, 1895. Insects. By J. T. Stinson.

Bulletin No. 34, January, 1895. Vegetable Gardening. By C. L. Newman.

*Bulletin No. 35, April, 1895. Animal Pathology. By R. R. Dinwiddie.

Bulletin No. 36, May, 1895. Grasses and Clovers. By R. L. Bennett.

*Bulletin No. 37, November, 1895. Syrups and Molasses. G. L. Teller, J. F. Moore, Assistant.

*Bulletin No. 38, January, 1896. Irish Potatoes. By C. L. Newman.

*Bulletin No. 39, January, 1896. Horticultural Division. Spraying Fruits. By J. T. Stinson.

*Bulletin No. 40, May, 1896. The Toxic Properties of Molds. By R. R. Dinwiddie.

Bulletin No. 41, August, 1896. Pork Production on Crops Gathered by Hogs. By R. L. Bennett.

Bulletin No. 42, October, 1896. Concerning Wheat and its Mill Products. By G. L. Teller.

Bulletin No. 43, December, 1896. Report of the Horticulturist. By J. T. Stinson.

Bulletin No. 44, January, 1897. Vegetable Gardening. By C. L. Newman.

*Bulletin No. 45, May, 1897. Milk, Its Composition and Preservation. By R. R. Dinwiddie.

Bulletin No. 46, July, 1897. Experiments with Manures and Rotation for Improving Worn Cotton Soils. Experiments on Beef and Pork Production in Connection Therewith. By R. L. Bennett.

Bulletin No. 47, October, 1897. Concerning Fertilizers and Manures. By G. L. Teller.

*Bulletin No. 48, November, 1897. Strawberries. By J. T. Stinson.

*Bulletin No. 49, January, 1898. Apple Bulletin. Preliminary Report on Arkansas Seedlings. By J. T. Stinson.

*Bulletin No. 50, January, 1898. Irish Potato Experiments. By C. L. Newman.

Bulletin No. 51, May, 1898. Methods of Combatting Communicable Diseases of Farm Animals. By R. R. Dinwiddie.

Bulletin No. 52, July, 1898. Feeding Experiments With Cotton Seed and Meal. By R. L. Bennett.

Bulletin No. 53, September, 1898. Chemistry of Wheat. By G. L. Teller.

*Bulletin No. 54, December, 1898. Feeding Test of Foods for Producing Pork. By R. L. Bennett.

Bulletin No. 55, December, 1898. Orchard Cultivation. By J. T. Stinson.

Bulletin No. 56, March, 1899. Tomatoes, Cabbage and Onions. By C. L. Newman.

*Bulletin No. 57, 1899, Relative Virulence for the Domestic Animal of Human and Bovine Tubercle. By R. R. Dinwiddie.

Bulletin No. 58, August, 1899. Grazing of Steers and Other Experiments. By R. L. Bennett.

Bulletin No. 59, December, 1899. Experiments with Corn in Different Latitudes. By C. L. Newman.

Bulletin No. 60, December, 1899. Second Report on Arkansas Seedling Apples. By J. T. Stinson.

Bulletin No. 61, July, 1900. Hay and Pasture Plants for Arkansas Soils. By R. L. Bennett.

Bulletin No. 62, November, 1900. Wheat Experiments. By C. L. Newman.

Bulletin No. 63, December, 1900. The Relative Susceptibility of the Domestic Animal to the Contagia of Human and Bovine Tuberculosis. By R. R. Dinwiddie.

Bulletin No. 64, December, 1900. Notes on Celery. By Ernest Walker.

Bulletin No. 65, December, 1900. Pig Feeding Experiments. By R. L. Bennett.

Bulletin No. 66, 1901. Oat Experiments. By C. L. Newman.

Bulletin No. 67, 1901. Investigations of Swine Disease in Arkansas. By R. R. Dinwiddie.

Bulletin No. 68, 1901. Soil Improvement and Forage Experiments. By R. L. Bennett.

Bulletin No. 69, 1901. Some Muskmelon Experiments. By Ernest Walker.

*Bulletin No. 70, 1901. Cowpea Experiments. By C. L. Newman.

Bulletin No. 71, 1902. Why Apple Trees Fail. By Ernest Walker.

Bulletin No. 72, 1902. Sweet Potato Experiments. By C. L. Newman.

Bulletin No. 73, 1902. Pork Production and Hog Ranching. By R. L. Bennett.

Bulletin No. 74, 1902. The Phosphate Rocks of Arkansas. By John C. Branner and John F. Newsom.

Bulletin No. 75, 1902. Alfalfa. By R. L. Bennett.

*Bulletin No. 76, 1902. Pig Feeding Experiments with Cotton Seed Meal. By R. R. Dinwiddie.

Bulletin No. 77, 1903. Cowpea Experiments. By C. L. Newman.

Bulletin No. 78, 1903. Experiments with Edible Oils. By J. F. Moore.

Bulletin No. 79, 1903. Peach Growing in Arkansas. By Ernest Walker.

*Bulletin No. 80, 1902. Cowpea Hay. By C. L. Newman.

Bulletin No. 81, 1904. Fertilizers. By A. M. Muckenfuss.

Bulletin No. 82, 1904. Live Stock Sanitation in Arkansas. By R. R. Dinwiddie.

Bulletin No. 83, 1904. Broom Corn Suggestions. By C. L. Newman.

Bulletin No. 84, 1904. Peanuts. C. L. Newman.

Bulletin No. 85, 1904. Cotton Food Products in Hog Feeding. By R. R. Dinwiddie.

Bulletin No. 86, 1905. Asparagus Growing in Arkansas. Rhubarb. By Ernest Walker. Fertilizers Registered for Sale in Arkansas in 1905. By A. M. Muckenfuss.

Bulletin No. 87, 1905. Glanders of Horses. By R. R. Dinwiddie.

Bulletin No. 88, 1905. Food Adulteration in Arkansas. By J. H. Norton.

Bulletin No. 89, 1906. Rice Growing in Arkansas. By W. G. Vincenheller.

Bulletin No. 90, 1906. The Cattle Tick in Washington and Benton Counties. By W. G. Vincenheller.

Bulletin No. 91, 1906. Suggestions Upon the Care of Apple Orchards. By Ernest Walker.

Bulletin No. 92, 1907. Some Insects of Orchard and Other Fruits. By C. F. Adams.

Bulletin No. 93, 1907. Cattle Tick Eradication in Northwest Arkansas. By W. G. Vincenheller.

Bulletin No. 94, 1907. Rice Culture. By R. J. Nelson.

Bulletin No. 95, 1907. Notes on Spraying and Suggestions for Combatting Crop Pests. By Ernest Walker.

FINANCIAL STATEMENT.

AGRICULTURAL EXPERIMENT STATION

In Account with the United States Appropriation, 1906-1907.

	Hatch Fund.	Adams Fund.
Dr.		
To Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1907, under Acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906) Adams' Fund)	$15,000.00	$ 7,000.00
Cr.		
By Salaries	8,613.48	3,577.03
Labor	1,631.73	814.54
Publications	613.10	....
Postage and Stationery	325.90	23.50
Freight and Express	535.68	31.84
Heat, Light, Water and Power	268.28	....
Chemical Supplies	76.64	214.50
Seeds, Plants and Sundry Supplies	700.89	228.27
Fertilizers	9.50	....
Feeding Stuffs	77.24	814.92
Library	158.93	138.52
Tools, Implements and Machinery	120.45	....
Furniture and Fixtures	133.64	116.50
Scientific Apparatus	....	476.70
Live Stock	595.00	192.43
Traveling Expenses	420.72	63.64
Contingent Expenses	15.00	....
Buildings and Land	703.82	307.61
Balance	......	....
Total	$15,000.00	$7,000.00

Dr.

To Receipts from other sources than the United States for the year ended........ ....

State, for the year ended Mar. 31, '07,	Farm Products	Dairy Products	Total
$8,063.57	$3,229.81	$2,109.87	$13,403.25

Cr.

By Salaries	5,409.73
Labor	666.31
Publications	....
Postage and Stationery	....
Freight and Express	10.55
Heat, Light and Water and Power	....
Chemical Supplies	....
Seeds, Plants and Sundry Supplies	562.41
Fertilizers	....
Feeding Stuffs	....
Library	....
Tools, Implements and Machinery	....
Furniture and Fixtures	16.55
Scientific Apparatus	....
Live Stock (Milk, and Expenses Running Dairy)	2,110.14
Traveling expenses	....
Contingent Expenses	3,131.51
Buildings and Land	1,341.05
Balance	155.00
Total	$13,403.25

The foregoing statements are copied from the Experiment Station books, which have been examined and approved by the Auditing Committee of the Board of Trustees, and is a correct statement of the expenditures from the Hatch, Adams' and miscellaneous funds for the year ended June 30, 1907, and from the State fund for the year ended March 31, 1907.

W. G. Vincenheller,
Director.

CODLING MOTH.

Carpocaspa pomonella.

The codling moth deserves first attention as it is one of the commonest of our orchard pests. The ''apple worm,'' or ''fruit worm'' are other names for this insect, or better, names for one stage of the moth's life history. These names readily identify the creature to the average fruit grower, or farmer, as every one is familiar with the worm in, what appears superficially to be, some of our choicest apples.

In visiting several of the apple districts of the state the writer has frequently heard complaints as to low prices on the apple market. These complaints have come from various individuals, numbers of individuals, or associations. The question is often asked as to why fruit from certain other states brings higher prices than that from Arkansas. The question is easily answered by stating that the other states are excelling in producing perfect fruit. As soon as the fruit from a given locality is known to be of the highest quality it obtains the highest price. To obtain the highest quality of fruit growers must take measures to protect their orchards from all pests.

There are generally two broods of larvae, or worms, of the codling moth. The eggs producing the first brood are generally laid, according to some observers, mostly on the leaves. Later in the season the moth lays her eggs more promiscuously on fruit and leaves. There seems to be some precaution on the part of the moth in not laying her eggs on the young fruit. As can easily be seen young apples are covered with fine hairs and as these are later lost by the apple the eggs likewise would be cast off. In from four to fifteen days the eggs hatch into larvae, or worms, about one-sixteenth of an inch in length, whitish in color, with each end black. The larva lives for a short time upon the surface of the apple, and then, when the latter is about an inch in diameter, begins eating its way into it. Of this first generation a large percentage enters at the calyx, or flower end, where the skin is more easily penetrated. Larvae of the second generation enter from the sides as well.

When the larva is full grown, that is, about twenty days old, it bores its way to the surface, seeks a place on the trunk, or on the ground if the apple has fallen, spins a cocoon about itself, and transforms into a resting stage, or pupa. In about two weeks the adult emerges and lays the eggs for the second brood.

The most common remedy for the codling moth is Paris green applied in the form of a spray. Probably the most efficient strength is as follows:

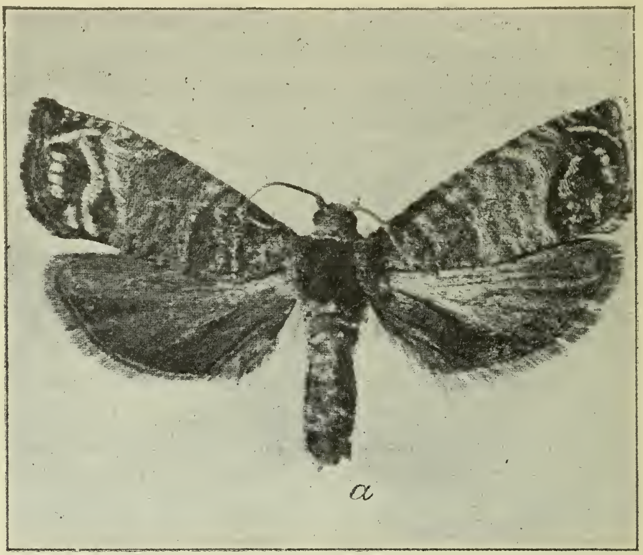


FIG. 1.

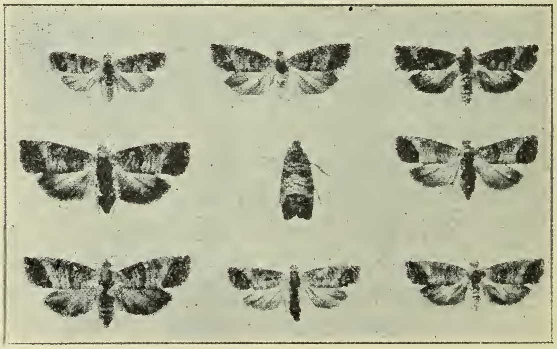


FIG. 2.

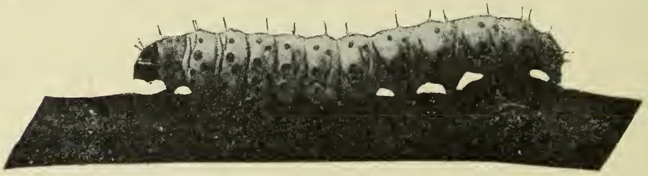


FIG. 3.
Codling Moth, Figures 1 and 3 enlarged, all after Cooley.

Paris green	1 pound.
Freshly slaked lime	2 pounds.
Water	160 gallons.

The above should be thoroughly mixed, and should be kept thoroughly stirred during application. This is necessary on account of the fact that the Paris green readily sinks to the bottom of the container, and if such should take place the application would be uneven and injury to the tree would result. Spraying machines provided with contrivances to keep the contents of the barrel or container thoroughly stirred should be used.

The time for spraying is the all important factor in dealing with such insects as the codling moth. The first application should be made as soon as the blossoms have nearly all fallen. It should be thoroughly applied so that each calyx or blossom cup is filled with the liquid. The application should be repeated in about a week. In case of heavy showers it should be repeated immediately. It is these first two sprayings upon which success depends. A third application should be given in about thirty days after the second, or as soon as the poison seems to have disappeared.

In addition to the spraying as described above it is often desirable and profitable to employ bands made from burlap to catch the larvae or worms which have otherwise escaped. The bands should be about ten inches wide, and long enough to pass completely around the tree, the ends slightly overlapping. It should be placed firmly around the tree, some distance above the ground, and then tied about the middle with a strong string. The top of the band can then be pulled down over the bottom part, making a double band of it. At intervals of a few days the band should be examined for larvae which have crawled up between the two folds. Often a great many can be trapped and killed by this simple device. Banding has not found favor in some quarters, but elsewhere it has proved a success.

The care of the premises, such as the fruit store-house, packing houses, and other buildings is an important item to consider in connection with the codling moth. Many larvae are brought in with the fruit when the latter is gathered, and escaping, spin a cocoon, and mature the following spring. These adults pass out through open windows and doors and are generally in sufficient numbers to infest a great many trees. The doors and windows should be screened to prevent the moths from escaping when they appear in the spring. At odd times when the moths are appearing the houses should be fumigated. Fumigation seems to be unsuccessful in destroying the larvae enclosed in their cocoons.

THE SAN JOSE SCALE.

Aspidiotus perniciosus.

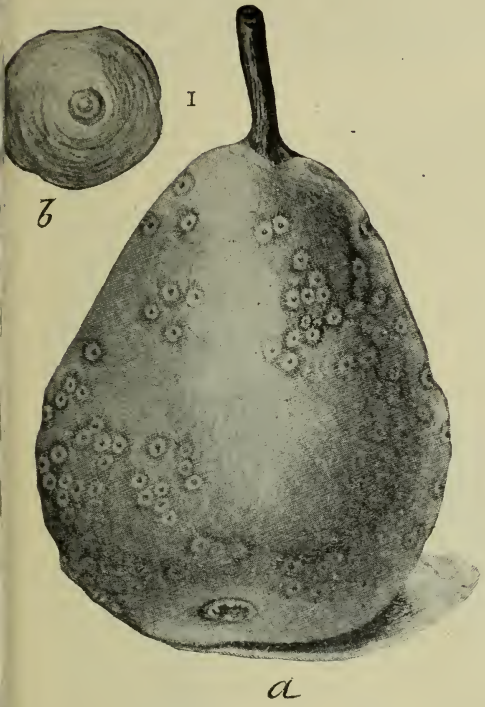
Another widely spread and very injurious insect in this country. A native of Japan, or China, it was introduced into this country through the western entry, and in a few years made its way to the eastern states. At the present writing, however, I know of it in this state only in a very few places. But this does not mean that it is not plentifully distributed throughout the state because a thorough inspection of the state has not been made. I expect to find it in various parts of the state.

The insect is easily overlooked by the casual observer, as it is quite small, and generally somewhat of the same coloring as its surroundings. The scales which covers the real insect, vary greatly in size, the larger ones about one twenty-fifth of an inch in diameter. The large scales being the adult females and the smaller ones immature individuals of both sexes. The scales are more or less irregularly circular, with the center nipple-like in appearance. This peculiar shape is used for its identification when seen only with the unaided eye, or low magnification. The insect itself is under the scale.

Early in spring females, which have hibernated, give birth to living young, and continue to do so for six weeks or more. The young are very small, orange-yellow in color, and are very active for a short while, running about on the twigs and leaves. Selecting a suitable place the young insect attaches itself to the tree by inserting its proboscis or beak into the bark. It then draws its legs up under its body and takes on a more or less circular form. The development of the scale, if not already begun, now starts, coming from a secretion in the form of small white filaments. The scale is produced by these filaments melting together. The adult male is very different from the female, being a free and winged creature. There are several generations during the season and when it is not combatted it becomes a very serious pest.

Probably the best time to fight this insect is when the trees are dormant, in the winter or early spring. The best remedy is the so-called lime, salt, and sulfur wash. The following is its formula:

Lump lime	20 pounds.
Sulfur	15 pounds.
Salt	10 pounds.
Water	50 gallons.



IG. 4.—San Jose Scale; *a*, pear, moderately infested—natural size; *b*, female scale—enlarged. (after Marlatt.)

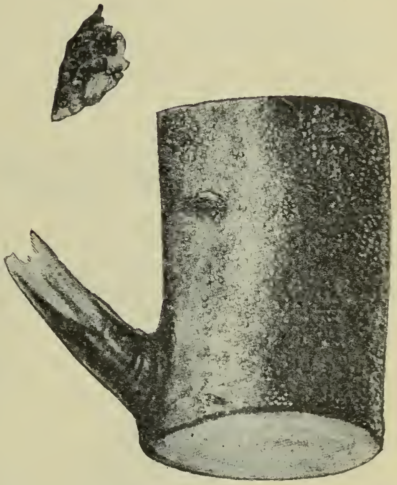


FIG. 5.—San Jose Scale: Apple branch with scales in situ—natural size; enlarged scales above, at left.(after Marlatt.)

Slake the lime with hot water in a kettle or barrel, and during this process slowly stir in the sulfur. Then boil for an hour or two, in about twenty-five gallons of water. The boiling should continue until a dark red color is produced. The salt should then be added and the boiling continued for fifteen minutes, strain, add twenty-five gallons of water and apply while hot.

Later in the season it would be safer to use kerosene emulsion. To make this spray use the following:

Soap	1 pound.
Kerosene	2 gallons.
Water	27 gallons.

Dissolve the soap in a gallon of water by boiling, remove from the fire and add two gallons of kerosene and stir until it takes the form of a creamy mass. It may require a second boiling to produce the emulsion. After the emulsion is made add the remainder of the water. Caution should be observed in making this spray as the kerosene might catch on fire. Kerosene emulsion is useful in combatting a great many insects such as plant lice and other scale insects.

APPLE TWIG BORER.

Amphicerus bicaudatus.

This insect is common on apple, cherry, pear, plum and grape. Is often referred to as the grape cane-borer. This beetle is about one-third to one-half inch in length, and dark brown above and black beneath. In early spring it enters the twig by making a hole near a bud, and continues its work by making a burrow several inches in length. The insect matures in the fall, there being but one brood,

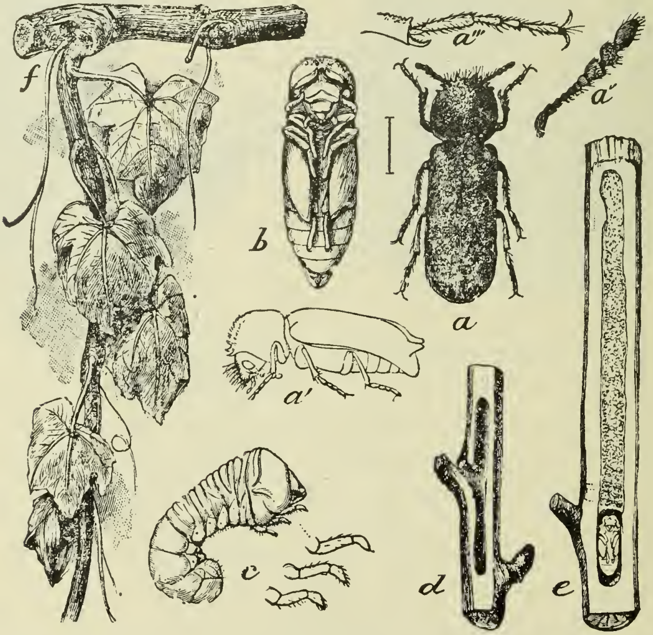


FIG. 6.—Apple Twig borer; *a*, beetle dorsal view; *a'*, beetle side view; *b*, pupa from beneath; *c*, grub, side view; *d*, apple twig showing burrow; *e*, burrow in tamerisk with pupa at bottom; *f*, stem of grape showing burrow. All enlarged except stems showing burrows. (Marlatt, Farmer's Bulletin 70, Div. Ent., U. S. Dept. of Agr.)

and for the most part, hibernates in its larval burrow. The eggs are laid in the dead or dying roots of "green brier" (smilax), or in dead roots of the grape.

This beetle will seldom become troublesome in a well kept orchard, as good pruning and general cleanliness about the place will remove all wood in which it is most likely to occur. If, however, a tree is infested the diseased part should be cut away and burned.

FLAT-HEADED APPLE BORER.

Chrysobothris femorata.

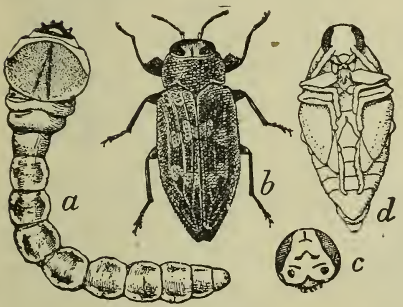


Fig. 7.—Flat headed Apple Tree borer; *a*, flat-headed larva; *b*, the mature beetle; *c*, head of mature beetle; *d*, pupa. All twice natural size. (Chittenden, Circular 32, U. S. Dep. of Agr., Div. of Entomology.)

This is one of the most common of the wood-borers of the apple tree. The eggs are laid on the bark in early summer, and the larvae or borers reach maturity in from one to three years. The borers are whitish grubs, living just beneath the bark of the apple, and other trees, and are recognized by the large flat head. The only remedy is to remove each borer by hand, using a knife of some kind. White-wash will often protect the tree if applied in late winter or early spring.

BUFFALO TREE HOPPER.

Ceresa bubalus.

This is one of the most injurious of the so-called tree hoppers. It takes its name from its shape, resembling somewhat a buffalo, but, of course, on a miniature scale. It is about one-third inch in length, light green in color, with yellow stripes on the sides. It injures the tree while depositing its eggs by making slits in the twigs. While the slits or wounds are slight yet they cause abnormal swellings which materially weaken the twigs, frequently causing them to break off. This, however, might be beneficial in an old orchard where the trees receive no pruning, but to young trees it is at times very injurious.

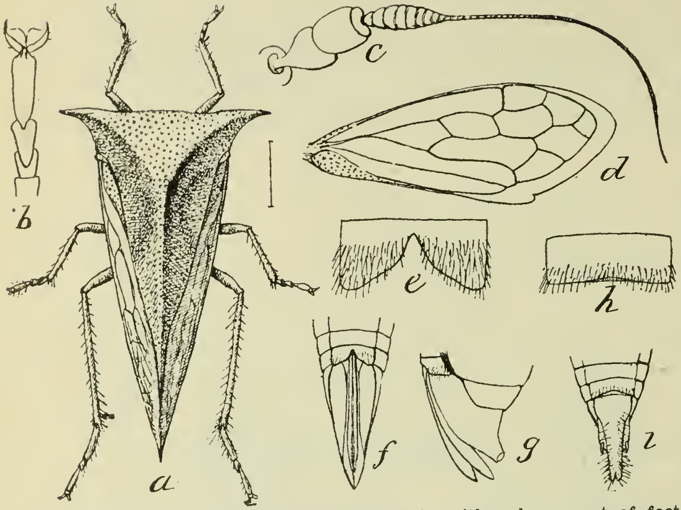


FIG. 8.—BUFFALO TREE-HOPPER; female (*a*), with enlargement of foot (*b*), antenna (*c*), wing (*d*), ovipositor (*f*, *g*), and terminal segment of male abdomen (*h*, *i*), after Marlatt.

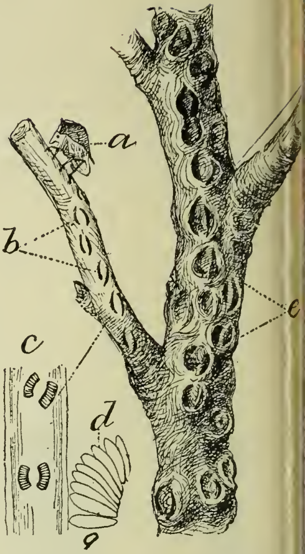


FIG. 9.—*Ceresa bubalus*, twig
ple showing: *a*, female at wo
recent egg-punctures; *c*, ba
versed with eggs in position,
ly enlarged; *d*, single row o
still more enlarged; *e*, wou
two or three years' standi
older limbs, (after Marlatt).

Infested twigs should be cut away and burned during winter and spring. The orchard and neighborhood should be kept free from weeds.

THE TWIG GIRDLER.

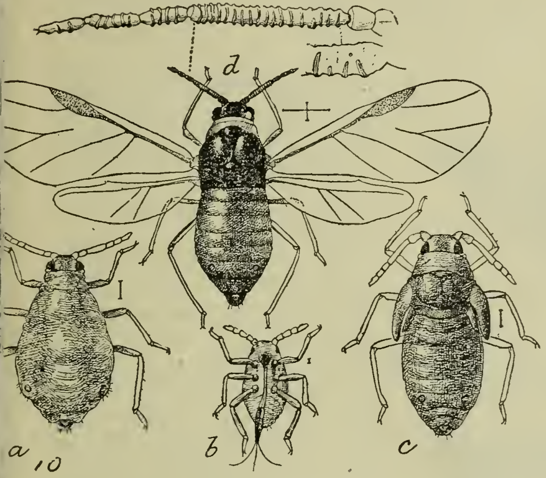
Oncideres cingulatus.

This beetle injures trees by girdling twigs, as the name implies, and causing them to break off at the slightest provocation. This habit is associated with that of egg laying. The insect lays an egg in a twig, and then girdles it a short distance below so that it is easily broken. The decaying twig furnishes a suitable place for the larva to mature. Keeping the orchard free from all fallen twigs is the usual method of combatting this insect.

THE WOOLLY APHIS.

Schizoneura lanigera.

In this state this plant louse, or aphis, is most often found on the roots of the apple tree. Some times it is found above ground, but this is when it has migrated up the tree trunk. The insect passes the winter generally in the egg stage. Sometimes those living on the roots pass through the winter as adults. The winter egg hatches in the spring, producing wingless, agamic forms which bear living young. These continue to so reproduce until late summer when the winged type appears. The sexual forms are wingless and mouthless, producing but a single egg, which passes the winter. Those living on the roots usually cause numerous galls or knots to form on the smaller roots. This causes greater injury to young trees than to the old ones. As the name indicates the insect is covered with a woolly secre-



. 10.—Woolly aphis (*Schizoneura lanigera*).—*a*, Agamic emale; *b*, larval louse; *c*, pupa; *d*, winged female with ntenna enlarged above; all greatly enlarged and with vaxy excretion removed, (after Marlatt).

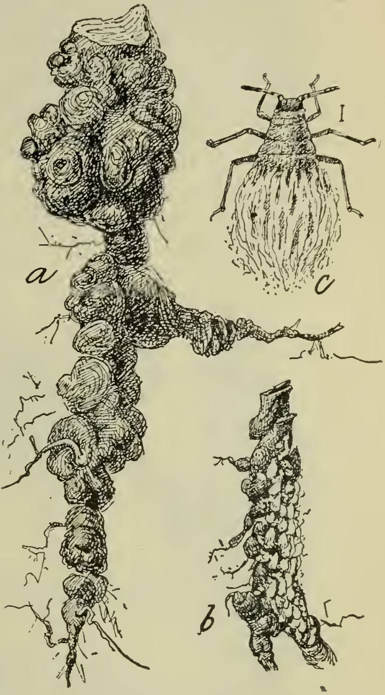


FIG. 11.—Woolly aphis (*Schizoneura lanigera*).—*a*, Root of young tree illustrating deformation; *b*, section of root with aphides clustered over it; *c*, root louse, female—*a* and b, natural size; *c*, much enlarged, (after Marlatt).

tion, somewhat resembling cotton, but more bluish in appearance. Beneath this covering the insect has a dull violet color.

When this insect attacks the tree above ground it may be combatted by using kerosene emulsion (see under San Jose Scale). If it appears very early in the spring pure kerosene may be used. To get at the form on the roots the earth must be removed from about the tree for a space of about two feet, put in half a dozen pounds of tobacco dust or twice that amount of tobacco stems, and cover well with earth. Tobacco is at least a good preventative for this insect but not so good as kerosene emulsion poured in the excavation instead.

THE PEAR TREE SLUG.

Eriocampoides limacina.

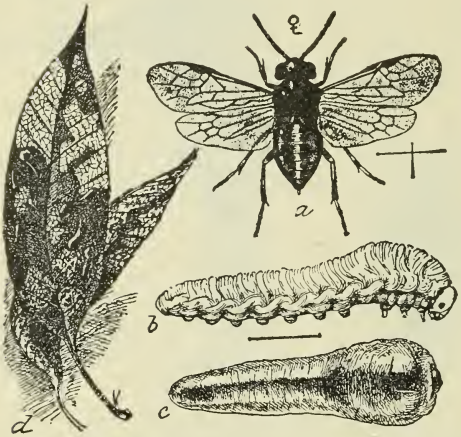


FIG. 12.—Pear tree Slug: *a*, adult fly; *b*, larva or slug with the slimy covering removed; *c*, same as preceding in natural condition; *d*, leaves showing slugs and their injuries. (Marlatt, Circular 26, Second Series, U. S. Dep. of Agr., Div. Entomology).

On the leaves of pear, plum, and cherry and other trees there can often be found a snail-like creature which is the larva, or "worm" stage of the above named insect. The larva is slimy, dark in color, with the head end very much enlarged. They injure the trees by feeding on the leaves, eating the upper surface. There are generally two broods. On account of its habits the insect can easily be combatted by spraying with Paris green (see under Codling Moth).

THE PLUM GOUGER.

Coccotorus prunicida.

The plum gouger is one of the so-called "snout beetles," about one quarter inch in length, general color gray, head and thorax (mid-region of body) yellowish. The beetle gnaws small holes in the young plums in which it deposits its eggs. The larva or grub hatching from the egg gnaws deeper and feeds on the kernel, and finally eats a hole out through the plum just before the latter matures.

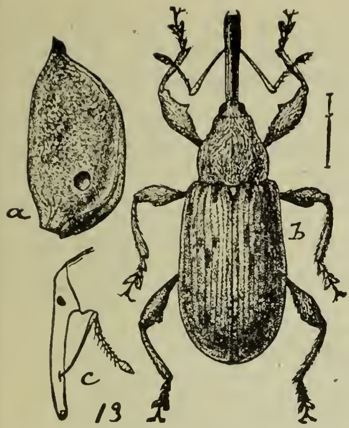


Fig. 13.—Plum Gouger: *a*, plum pit showing hole for exit of gouger; *b*, gouger; *c*, side view of head of gouger showing beak and antenna (Riley & Howard, Insect Life, Vol. II., U. S. Dep. of Agr., Div. of Entomology).

In a well kept orchard which is sprayed with some of the arsenical poisons, such as Paris green, the insect is not liable to do much damage. These poisons should be applied in weaker strengths for plums, about two-thirds to three-fourths the strength as is used for apple. One method is to jar the tree early in the morning from the time the blossoms are on until the beetles seem to have disappeared. In this practice the beetles should be caught in sheets spread on the ground under the tree, and destroyed.

THE PLUM CURCULIO.

Conotrachelus nenuphar.

This is another "snout" beetle but is smaller than the preceding species, is brown to blackish in color, and has two pronounced humps and numerous smaller ones on its back. This insect is considered by some to be the most destructive orchard pest we have, classing it with the codling moth. It passes the winter in the adult stage and in early spring begins feeding upon the buds and leaves of plum, apple, peach, pear and other trees. When the young fruit has attained some size the beetle makes a crescent-shaped slit in it, and in this lays an egg. In a few days the egg hatches into a small whitish larva, or grub, which bores its way to the seed. In case of the plum, peach, apricot and cherry most of the infested fruit falls, in the plum

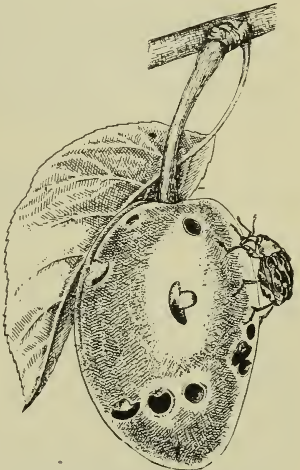


Fig. 14.—The plum curculio: Adult female on plum, showing the circular feeding punctures and the crescentic egg-laying punctures. Enlarged, (after Johnson & Girault).

practically all. Apples and pears do not drop from the effect of this insect, but if they should drop from some other cause, then the curculio larva will mature. The larva reaches maturity about midsummer, leaves the fruit and goes beneath the ground to pupate, or change into the pupal or resting stage, from which it transforms, a short time after, to the adult or beetle stage.

There are many opinions as to the preventative measure for this insect. The "jarring" mentioned under the plum gouger will do a great deal of good here. The use of poisons is, however, to be recommended. Apples and pears may be sprayed with the usual strength of Paris green, plums and others with a weaker strength. It is generally an excellent plan to add the Paris green to Bordeaux mixture when the latter is being used as a fungicide.

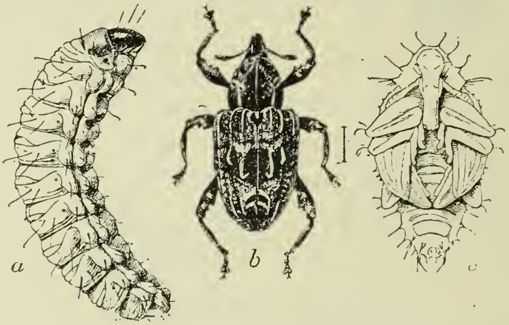


FIG. 15.—The plum curculio (*Conotrachelus nenuphar*): *a*, larva; *b*, adult; *c*, pupa. Much enlarged (hair line to right of *b* indicates natural length of adult). (From Chittenden.)

THE PEACH BORER.

Sanninoidea exitiosa.

This is probably the most injurious pest of the peach in this state. It confines its attacks to the trunk and roots, feeding at or just beneath the surface of the ground. It is known to most peach growers in its larval or borer stage only. Some growers, however, have noticed also the pupal, or resting stage, for this is to be seen in the same location where search is being made for the borer.

The insect passes the winter in the larval or borer stage. It stays either in the burrow or constructs a cocoon-like structure, termed hibernaculum. This consists of bits of bark and other material held together by silken threads spun by the borer. The hibernaculum seems to be a protection to the borer principally from the gummy materials which exudes from the injured tree.

In spring the larvae transforms to pupae, and these in about three weeks transforms to the adult moths. Contrary to the habits of most moths this insect emerges and flies about during the day time. The adults may be seen flying about the peach trees in late spring or early summer. They are easily disturbed and will fly away seeking the base of a near-by tree. Early summer is when they are probably most abundant, but they are to be seen much later in the season.

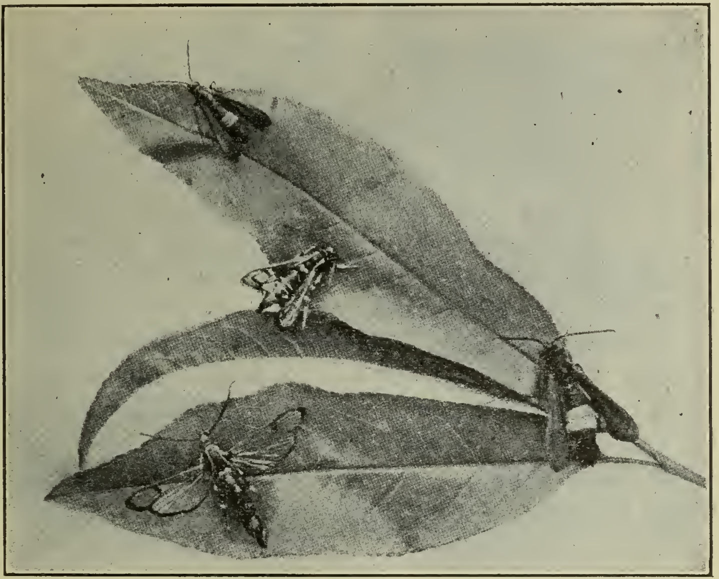


Fig. 16.—Moths of Peach Borer. After Slingerland.

Egg laying takes place in the day time, during the season when the adults or moths are active. The length of time it takes the egg to hatch is an unsettled point, probably from eight to ten days. Upon hatching the young borers, or larvae, are very active and seek a crack in the bark through which to enter and feed on the inner bark. This feeding continues until they hibernate, or in mild winters until the following spring when they pupate, or transform into the pupal or resting stage.

In combatting this insect the grower must take up a hand-to-hand fight, especially where the tree is already infested. The best thing to do is to make an individual search about each tree and remove by hand the borers, using some instruments such as a large pocket knife. During late fall, or in some parts of the state in winter, is the best time to destroy the borers. The method consists simply of removing some of the soil from around the base of the tree and cutting out or in some manner destroying the borers in their burrows. The borers may be located by the presence of a gummy material which exudes from the opening of the burrow. By scraping this material away one can easily find and destroy the borer. It is a good idea to remove the soil from around the tree some days before any attempt is made to find the borer, because the fresh material thrown out by the larva is more easily seen then than if the soil left on the tree is fresh.

As a preventative for this insect "mounding" can be practiced with considerable success. This consists merely of throwing up the soil eight or ten inches high about the base of the tree. This should be done in the spring. If it is convenient it makes an excellent combination to add tobacco stems to the base of the tree before the mound is made. There have been many schemes devised to protect the trees from this insect but most of them are valueless. The best method is probably the one outlined above, that is, first digging the borers out by hand and then applying tobacco stems to the base of the tree and hilling up the earth.

THE PEACH TWIG BORER.

Anarsia lineatella.

This insect is found infesting strawberries but in some places it proves to be a very serious pest of the peach. The larva begins its work early in spring by eating into the buds as the latter open. The young twigs are attacked and injured to such an extent that they wilt and die. Later in the season the fruit itself is eaten by the borer and the gummy exudation so common to the peach is the result of this injury. In the fall of the year the larva excavate in the bark of the tree small cavities wherein they pass the winter. Some idea of the different stages of this insect can be obtained from the accompanying figures.

When the pest is known to exist the trees should receive an application of the lime, salt and sulfur wash early in the spring, (see

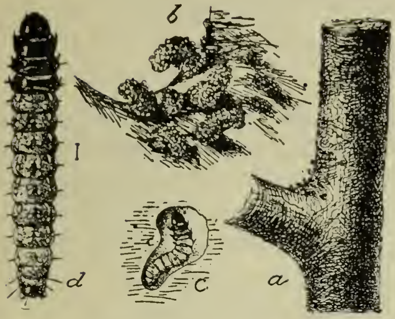


FIG. 17.—Peach Twig borer: *a*, twig of peach showing little masses of chewed bark above the larval burrows; *b*, the same enlarged; *c*, larva in winter burrow, enlarged; *d*, hibernating larva greatly enlarged. (Marlatt, Bulletin 10, N. S., U. S. Dept of Agr., Div. of Entomology.)

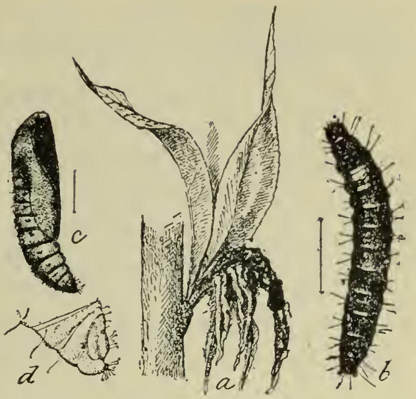


FIG. 18.—Peach Twig and Borer: *a*, young shoot wilting from attack of borer; *b*, adult larva enlarged; *c*, chrysalis enlarged; *d*, tail end of chrysalis showing hooks. (Marlatt, Bulletin 10, N. S., U. S. Dep. of Agr., Div. of Entomology.)

under San Jose Scale). Many of the larvae can be caught, later in the season, by using bands as for the codling moth.

THE BLACKBERRY CROWN BORER.

Bembecia marginata.

This insect has proven to be a very destructive pest in certain parts of this state. The moth lays its eggs upon the blackberry canes, and the larvae hatching from these bore into them and finally down to the roots. A sudden wilting of the new shoots indicate the presence of this creature. It takes two years for this insect to mature, the larva pupating in the fall of the second year of its life. The pupal or resting stage is passed in the larval burrow. Like all insects with similar habits the only way to satisfactorily combat it is to cut out and destroy the larvae as soon as they are detected.

THE STRAWBERRY CROWN BORER.

Tyloderma fragariae.

The adult of this insect lays its eggs by first eating a hole through the bud scales which cover the crown of the plant and then depositing the eggs in it; or by making excavations in the stems at or near the ground and after depositing the eggs therein, closing them with debris. These eggs hatch into small yellowish or whitish grubs or larvae which bore into the crown of the plant.

As a preventative the plants should not be allowed to get old, that is, there should be more frequent change of location of the strawberry field or beds. If the field should once become badly infested it should be ploughed out and the plants destroyed.

THE STRAWBERRY ROOT BORER.

Paria aterrima.

This is another beetle whose larva feeds upon the strawberry plant. The larvae are whitish, and confine their attention to the roots of the plants. As in the preceding species it is best to practice a definite rotation of the beds or fields as a preventative, and also to spray with Paris green when the adults are noticed on the plants. If the field becomes badly infested it should be ploughed out and the plants destroyed as soon as the berries have been picked.

THE STRAWBERRY WEEVIL.

Anthonomus signatus.

This is one of the most troublesome pests of the strawberry plant. The small blackish beetle lays its eggs in the young buds and then punctures the flower stalk below the bud so that development is stopped. The larva feeds upon the pollen of the bud and reaches maturity in about a month. The beetle can be easily recognized, generally, from other beetles feeding on the strawberry plant by the snout which is characteristic of the group to which it belongs.

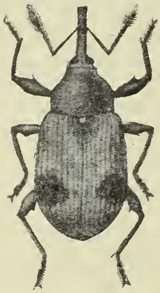


FIG. 19. — *Anthonomus signatus*: adult beetle —greatly enlarged, (after Chittenden.)

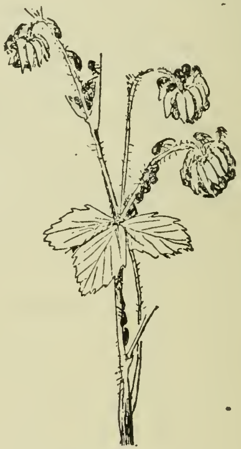


FIG. 20.—Spray of strawberry plant showing weevils at work—natural size (from Riley).

This is a difficult insect to combat. It has been recommended that early-flowering varieties of strawberries, such as "Charles Downing" be planted in such location as will serve to attract the beetles upon their first appearance. If this is successful in causing the beetles to mass together they can be sprayed with kerosene emulsion or even pure kerosene. If there are woods in the neighborhood of the field these early flowering varieties should be planted near them, for the beetles are most likely to be in that part of the field. It is also interesting to know that redbud trees will attract these insects before the beetles have begun to infest the strawberry. If it is convenient to have some redbud trees in the field they should be watched early in the season and as soon as the beetles begin to collect on them they should be gathered by the "jarring" method and destroyed.

THE STRAWBERRY LEAF ROLLER.

Ancylis comptana.

This insect can most easily be recognized by its larval stage, especially by its manner of folding a leaf in order to make for itself a habitat. An adequate idea of this insect can be had from the accompanying figures. If one of these folded leaves be examined it will be seen that the folds are held together by fine silken threads. These were spun by the brownish or greenish larva which will nearly always be found between the folds. The larva does its greatest damage by eating the lining surface of its abode.

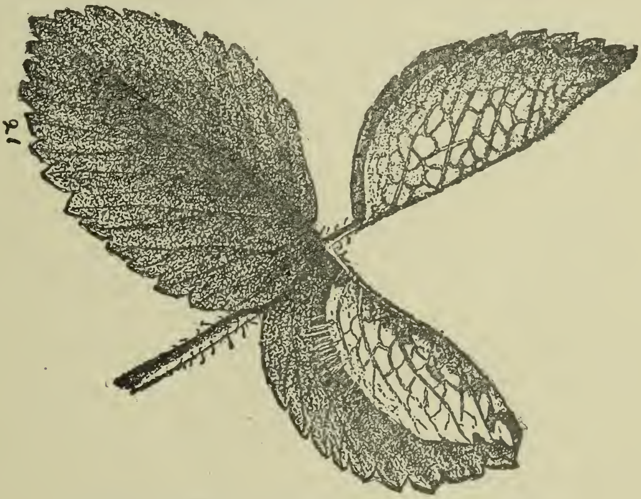


FIG. 21.—Strawberry leaves showing their appearance after being folded by the roller. (After Weea.)

The larvae cannot be reached very easily by poisons, so the only practical way of combatting this species is to scatter straw over the vines, after the berries are gathered, and burn it. If done early enough this will not damage the vines.

TICK ERADICATION IN NORTHWESTERN ARKANSAS.

In a previous report on the ''Cattle Tick in Washington and Benton Counties'' (Bul. No. 90.), it was explained how the increasing prevalence of cattle ticks in those counties worked to the detriment of the cattle industry and therefore indirectly to all branches of agriculture. This impediment to agriculture in the south has, in the last few years come to be generally recognized, and a movement has been started in most of the Southern States to clean up or free from ticks those parts of each State most favorably situated for this work. This movement, known officially as ''Tick Eradication,'' has received the indorsement and financial support of the Federal Government and an appropriation was allowed by the last Congress to aid in this work those States which showed a disposition to undertake the work in co-operation with the Department of Agriculture. Arkansas has need to avail herself of every movement which promises to increase the value of the farmers' livestock and the Experiment Station has therefore, during the past summer, made a beginning of this tick eradication work in northwest Arkansas, acting in co-operation with the U. S. Department of Agriculture. The work so far accomplished is slight as compared with that of some of the neighboring States—Oklahoma and Texas especially, but it is expected that it will be greatly extended during the next and succeeding years until all the northern counties, above the old State quarantine line, are again free from the necessity of all quarantine restrictions. The farmer may then expect a market for his cattle which will yield him some return above the cost of raising them. Since this work was commenced, four inspectors—two from the U. S. Agriculture Department and two in the employ of the Experiment Station—have been making a preliminary inspection of all cattle stock in Benton and Washington Counties, beginning at the western boundary. The main facts and figures revealed by this inspection are included in this report.

The U. S. Quarantine line, running along the northern boundary of Arkansas, is not merely a red line on the map. It separates the territory north, free or practically so, of ticks from the territory south which is more or less plentifully supplied with the true cattle tick, the carrier of the Texas fever germ.

To be below this line means to labor under considerable disadvantage as far as the cattle industry is concerned; for not only are cattle not allowed to be moved north, other than for immediate slaughter, except during the "open season," and then, into some States, only after inspection by a Federal Inspector, but the price paid for "Southern" cattle is notably lower than for the same cattle if raised above the line. These restrictions occasion considerable loss to cattle raisers south of the Federal quarantine line.

In addition to these losses, due to our position below the Federal quarantine line, there are the losses by death from Texas fever and the dangers in introducing pure-bred stock from the North for improving the breeds. The actual losses by death from Texas fever are, as a rule, greater where tick infestation is only slight; for where ticks are very numerous, the cattle generally become immunised while quite young and not susceptible; thus there are more cattle die in those districts bordering on the line than in those farther south where the tick is more constant.

The removal of the quarantine line, dependant as it is, on the extermination of the cattle tick, removes all these restrictions, enhances the value of stock and makes it possible to improve herds and compete in Northern stock shows. With the extermination of the tick comes absolute safety from Texas fever since the tick is the only means of introducing the germ under normal conditions.

If the country adjoining the quarantine line can be cleaned, that is if the ticks can be exterminated, there is no longer any need for the line to retain its present position and as the country becomes clean it will be put further south. As the boundary of the ticky areas goes south, the quarantine line will follow it up till, in the course of time, it will coincide with the coast line and this continent be entirely free of this pest. This happy result will, of necessity, be a slow process but there is no reason why the quarantine should not be considerably modified within the next year:—the Government restrictions and those of neighboring States will be removed as soon as the situation will admit of it.

The climate and position of Northern Arkansas and the comparative scarcity of ticks makes the outlook encouraging for those interested in the work and this includes, of course, everyone who owns a cow. It is altogether probable that in many parts of Northern Arkansas the ''fever'' tick is brought in each year from the south and west and is not a native at all; large areas are entirely free.

The advantages expected to result from a successful prosecution of this tick exterminating work require to be presented in the most lucid and emphatic manner possible because the sympathy and cooperation of the farmer is a necessity to it. Until he learns to see in it something more than a scheme of the Government to furnish ''soft jobs'' for its employees, there is no progress possible. So far the number who have expressed this idea is small and of little influence compared with those who are warmly in sympathy with the undertaking.

Cattle raising in this section of the State is not a large industry and what there is of it is far from profitable. It is unprofitable chiefly for lack of a proper market, and the market is lacking on account of the National quarantine and the various State quarantines which prohibit the transportation of cattle from Arkansas to meet the demand of Missouri and other corn raising States for ''feeders.'' With these restrictions removed, Arkansas stock raisers would at least be on an equal footing with those of Southern Missouri. But an argument more convincing than theory, is found in the experience of those localities where, in limited areas, the work of tick eradication has been completed and quarantine restrictions removed. In such localities, as in portions of Virginia, Tennessee, North Carolina and Texas, even those farmers who were at first sceptical or indifferent have now become most appreciative. In one county in Texas, it is reported that a bonus of twenty thousand dollars, in aid of this work, has been promised by the citizens when that county is clear of ticks. What is good for Texas or Virginia ought also to be good for Arkansas.

REPORT OF WORK DONE IN ARKANSAS IN 1906.

In July (1906), this Station, working in conjunction with inspectors from the Bureau of Animal Industry, started to canvass Northwestern Arkansas with a view to determining the exact state of the country as regards ''Texas fever'' ticks (Boophilus annulatus).

The original plan was to locate all the infected areas and then hold a series of meetings giving a short discourse on the tick and its relation to Texas fever and discussing with the farming community measures for stamping out the existing infection and preventing re-infection.

In Benton County the work was begun in July and carried on till the ''open season'' started on November 1. During that time about two thirds of the county was travelled.

During that time a total of 7474 was inspected, of which 1481 were found to be tick infested leaving 5993 clean.

This result seems to be very favorable and should be a great incentive to those having ticky cattle to take measures for cleaning them and keeping them clean. The map of Benton County shows the amount of territory covered and the infected areas in red.

In Washington County the work was not begun till late in the season so that comparatively little ground was covered. 2003 cattle were inspected, of which 903 were found ''ticky,'' leaving 1100 clean.

CONCLUSIONS ARRIVED AT.

Indifference of some of the stock owners: Many of the farmers and stock owners in Benton County, who have lost cattle subsequent to the driving through of Southern (''ticky'') cattle have been convinced that the tick was in some way responsible for their losses,—others still argue the point. It is not proposed here to go into any discussion on that subject (the fact has been too well demonstrated and proved to admit of argument) but merely to suggest that every farmer should, if he has not already done so, obtain the free literature on the subject published at this Station and at the Bureau of Animal Industry.

It must be borne in mind that every full grown tick that is allowed to drop off, lays from 1500 to 3000 eggs and these eggs hatching out, produce that number of little ''seed'' ticks; these in their turn, maturing on their bovine hosts, reproduce each its thousands of larval ticks. In this way, it is easily to be seen that the carelessness or indifference of one man may counteract the work of all. The better class of intelligent and up-to-date farmers and stock owners was willing and eager to do all in their power, both by precept and example, to forward the important work of tick eradication.

FACTORS IN KEEPING UP THE INFECTION.

The main factors in keeping up the infection in the northwest are:

(1) *The driving in of cattle* from the west (Indian Territory) and south. As this is prohibited by Act LIX, 1901 and Act XIII, 1899, of the Statutes of Arkansas, the remedy lies, very largely, in the hands of those along the route taken by such cattle and as these people are the principal losers it is difficult to understand why they tamely submit to having their cattle killed in this manner—for losses almost invariably occur along the route taken by these western or southern cattle.

(2) *The Railroads.* It is a little difficult to see how this can be remedied except by keeping cattle in pastures and not allowing them to run at large along railroads where ticks may drop from Southern cattle. Of course, if the right-of-way were fenced and no ticky cattle allowed to be unloaded except in special quarantine pens the danger of infection from this source would be minimised. The danger is greatest where, as at Gravette, two lines intersect and cattle are sometimes detrained at one depot and driven over to the other for reshipment. A case in point is the infection, this year of the town cows of Gravette. Previous to September 1, (1906), these cows had been inspected and found clean; on that date however, two carloads of ticky cattle were brought from Grove, (I. T.), detrained, and driven across for reshipment on the K. C. S. These cattle, heavily infested with ticks, stampeded and scattered the infection over quite a large area. Subsequent reports show nearly all the town cows infested with ticks.

(3) *The Range.* This the main factor in propagating and distributing the tick, when once introduced, will, in the course of time, naturally diminish as the land becomes more thickly settled. A glance at the Texas fever map shows that the country is most infested where abundant range exists,—the main infested areas coinciding with the main tracts of unfenced range, e. g., the northwest and southwest corners of the county. In the more thickly populated districts where nearly all the land is taken up and little or no range exists, the fever tick is rare.

Were a general herd law in force, the question would become, if not a simple one, at any rate a much less difficult one than it is at present. The great majority of the farmers in these two counties are in favor of such a law and the legislation needed for this end will be sought for during the next legislative session.

SUMMARY.

Briefly summing up the evidence so far collected, we find, in Benton County, a little less than 20 per cent of ticky cattle and most of these infected from I. T. In view of the many advantages accruing from the removal of the quarantine, it behooves every man to co-operate and offer all the help he can to inspectors or others who may be working on tick eradication.

A few pointers which it would be useful to follow:

Get Farmers' bulletin No. 258 and any other free literature from the Bureau and from this Station and read it.

Clean up your own cattle and your own pastures.

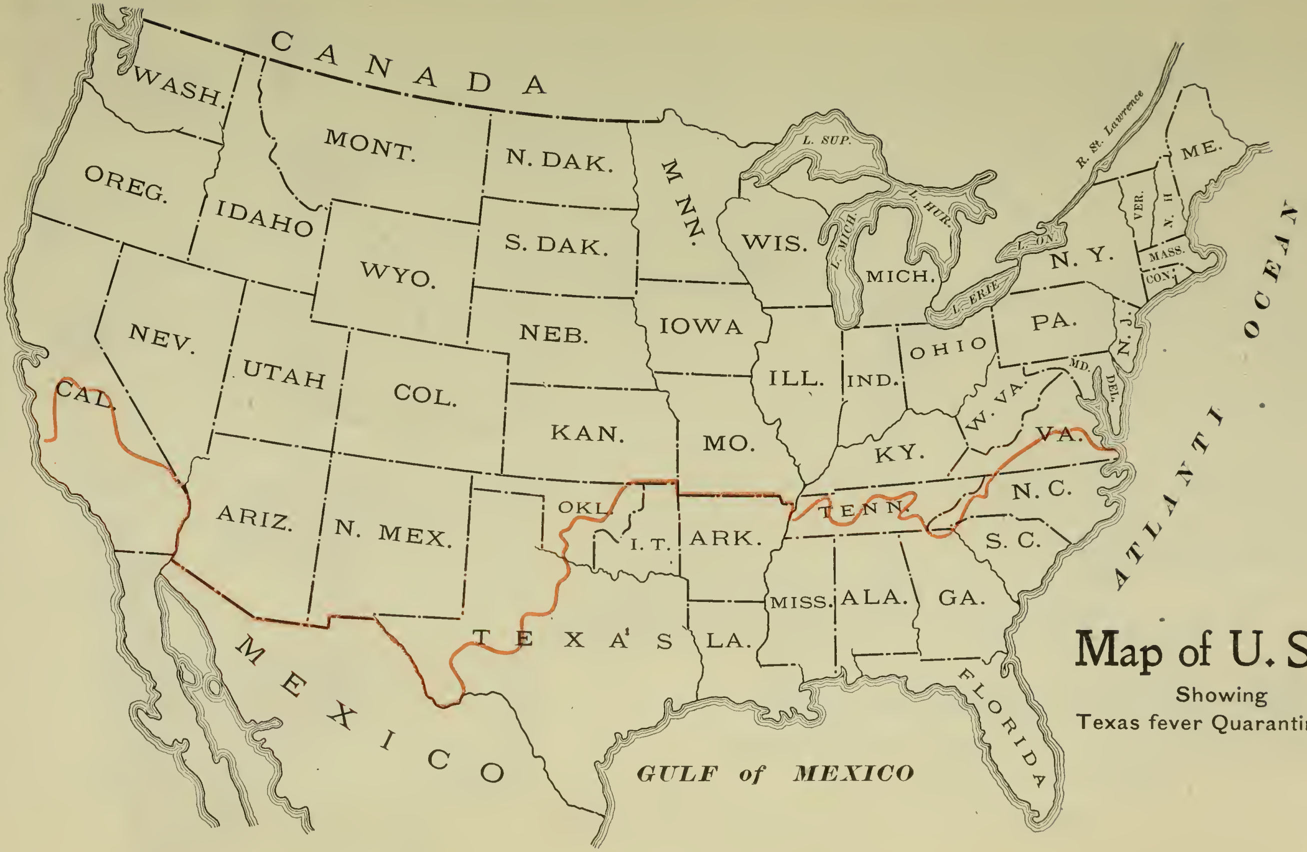
Get your neighbor to follow suit.

Vote for a general herd law.

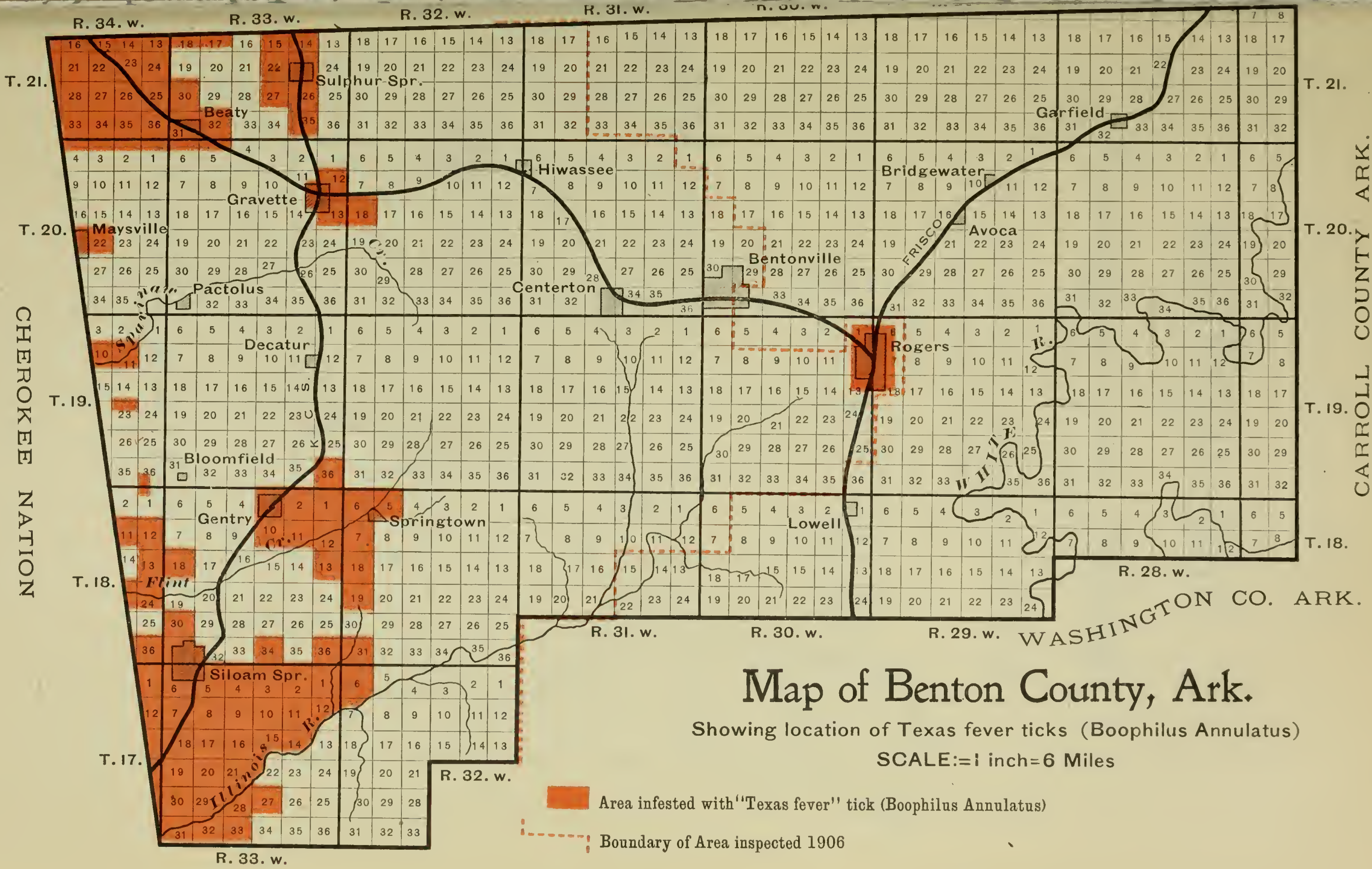
Don't buy cattle in an infected district or if you do, make sure that they are tick free—oil them before putting them into your pastures. (Use crude petroleum or any cheap oil.)

Don't allow your cattle to run on the range.

Don't allow infringements of the law to pass without protest; you may be a heavy loser from the introduction of disease.



Map of U. S. A.
Showing
Texas fever Quarantine Line



Map of Benton County, Ark.

Showing location of Texas fever ticks (Boophilus Annulatus)

SCALE:=1 inch=6 Miles

🟧 Area infested with "Texas fever" tick (Boophilus Annulatus)

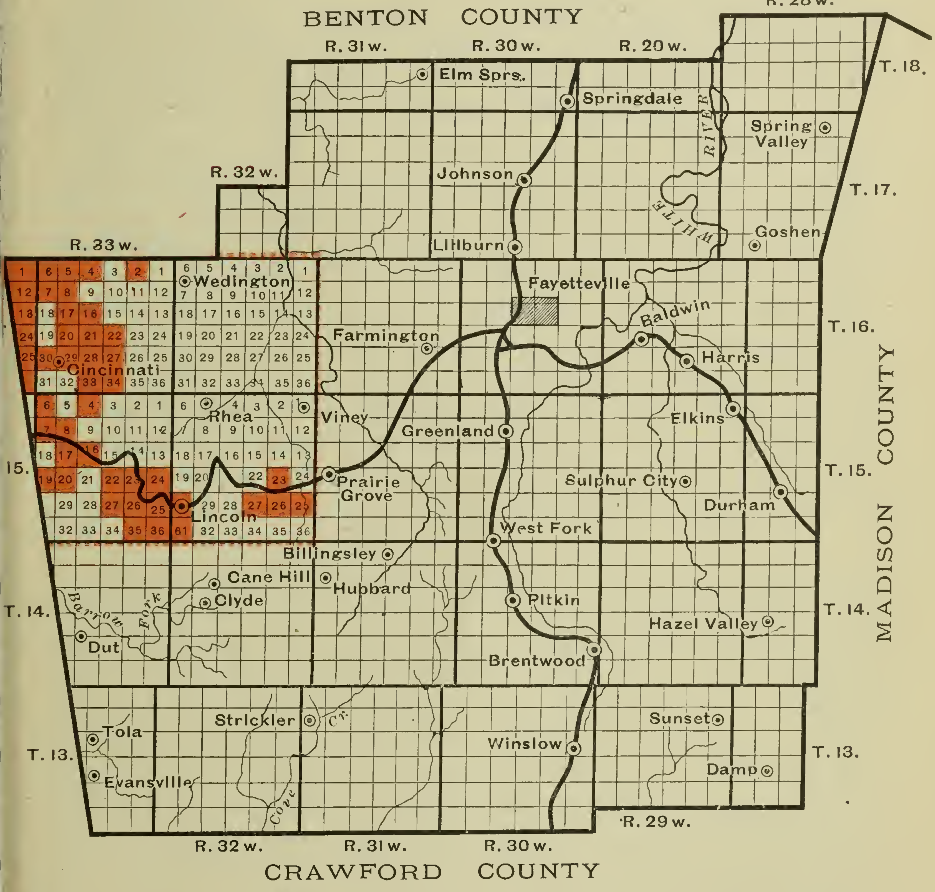
┆ Boundary of Area inspected 1906

SECTIONAL MAP
of
Washington County, Arkansas.

SCALE: I inch=6Miles

🟧 Area infested with "Texas fever" ticks (Boophilus Annulatus)

┄ Boundary of Area inspected 1906



RICE CULTURE.

By R. J. Nelson, Field Agent.

INTRODUCTION.

The evolution of rice growing in Arkansas has brought many inquiries to the station for information on this subject. Bulletin 89, ''Rice Growing in Arkansas,'' was issued last year, and it is believed that it has been a benefit to beginners in this industry.

Since the crop of 1905, the acreage of rice in Arkansas has increased enormously. From 450 acres in Lonoke County, the area in rice in 1906 numbers about five thousand acres; the industry having extended to Prairie, Arkansas, Lee, and St. Francis counties. The yield will not be far from 105,000 bushels. Judging from the inquiries, the acreage will be very greatly increased this year, 1907.

In addition to close study and observation of the rice experiments at the Lonoke branch station for two years, every rice farm in the rice growing district has been visited and information gathered from the successful rice growers of Arkansas, and elsewhere. Information contained in this bulletin on the feeding value of by-products is gathered from Louisiana and Texas Experiment Stations and the U. S. Department of Agriculture.

The year 1906 was in many respects a very unfavorable season for growing rice. The excessive rains in the autumn of 1905 were a serious menace to the matured crop. Harvest was delayed in consequence as little fall plowing could be done. In fact the excessive rains and cold weather continued through the winter of 1905-06 until late in the spring. When the proper season arrived for planting few growers had their land ready for sowing. This was very unfortunate, for rice lands not plowed early and allowed the effects of winter rains and freezes are very difficult to pulverize and get in good tilth for seeding. Much of the crop of 1906 was planted too late, and as so often happens with late sowing the cool weather in late summer and early fall, and the ''showery period'' prevented pollination; consequently, there was much "light rice." A hard rain and wind-storm on the 23rd of September damaged the crop from five to twelve per cent. Late planting had not been harvested, hence suffered most. But the most serious damage was from the early frost in October. The early planting was matured and for the most part harvested before the storm, hence escaped. The late crop was almost ruined. The weather was favorable during the reaping season of the early crop, but there were heavy rains in the late fall so that the late sowing was saved with great difficulty.

Some growers had great difficulty in getting their wells. Mistakes were made in purchasing pumps, engines, boilers, etc., and in installing pumping plants. The demand for well-contractors was so great and the immediate needs of the young plants for water so urgent, that inexperienced men in some cases had to be employed to sink wells. As may have been expected, men not familiar with the water-bearing stratum did not understand where the strainer should be suspended. Several wells collapsed as a result of the strainer having been placed in quicksand. Some secured good wells, but too late to save the crop which had already been planted, and which suffered for irrigation. Pitless pumps and air compressors in most cases were very unsatisfactory. They caused an enormous expense for fuel, failed to give the guaranteed volume of water, and resulted in much loss to the growers.

Notwithstanding the unfavorable season of 1906, where the land was well prepared, the crop planted early, irrigated properly, and harvested timely, the yield was satisfactory. While it was not as much as it should have been, for reasons above mentioned, it will not be far from 105,000 bushels, which is considerable when we remember that the industry has only just begun. It must be borne in mind that the lands now bringing revenue to the growers in rice are lands that, owing to lack of drainage and reclamation, were not adapted to field crops; being used almost exclusively for grazing.

There is no longer a doubt that rice is adapted to the prairie lands of southern Arkansas. Where the crop is managed properly it is believed that it is even more certain than the ordinary cereal crops of that section, and should be profitable. It is a fact known to agriculturists that there are fewer insects and fungus diseases as yet to ravage the rice plant than any other plant so extensively cultivated. However, the skillful rice grower will be on the alert for any suspicious weed, insect, or fungus disease.

THE EXPERIMENT STATION CROP OF 1906.

As has already been stated, the heavy rains in fall and winter of 1905 prevented early plowing. It was April 16th, 1906, before all of the stubble was turned; April 28th when the sod was finished. As may have been expected the land was very rough and cloddy. It was necessary to disc three times with four-horse disc and follow with smoothing harrow. No grain drill being at hand, the seed was sown broadcast by hand at the rate of from 1¼ to 1½ bushels to the acre. The seed was then disced in and crossed with smoothing harrow. Except on a small space where the land was badly drained and where it had to be plowed when very wet, a good stand was secured. It will be seen from the table given below (Plat No. 1), that the first sowing was April 20, and that the maximum yield 77.76 bushels to the acre was harvested from that plat. Contrary to the experience of two years, the Honduras produced the maximum yield, but this is accounted for by the fact that the Japan plats were all planted much later, suffered from storms, early frost, cool nights, and other unfavorable things mentioned above. Japan sown in sod land by the side of Honduras also on sod, at the same time and cultivated the same, made a much better yield.

TABLE No. 1.

Plat	Variety	Acres	When Planted	Water Turned On	Water Turned Off	Irrigation Period	Remarks
1	Honduras	4.	April 20	June 4	Aug. 24	82 days	Yield 77.76 bu. per acre
2	Honduras	9.93	April 28	June 7	Aug. 29	82 days	
3	Honduras	3.	April 23	June 10	Sept. 3	83 days	
4	Japan	6.97	May 10	July 5	Sept. 30	85 days	Damaged by Storm
5	Japan	2.	May 12	July 8	Oct. 2	85 days	Damaged by Storm
6	Japan	2.1	May 12	July 8	Oct. 2	85 days	Damaged by Storm
7	Japan	6.	May 15	July 10	Oct. 4	85 days	Damaged by Storm
8	Honduras	6.	May 16	July 10	Oct. 4	85 days	Much light rice failed to pollinate

Average: Acres, 40; Irrigation period, 84 days.

TABLE No. 2.

Variety	Acres Planted	Acres Harvested	Total Yield	Average per Acre	Lost by Storm
Honduras	22.93	22.93	1,418.05 bu.	61.84 bu.	
Japan	17.07	17.07	885.31 bu.	52.44 bu.	5%
Total	40.	40.	2,303.36 bu.	57.5 bu.	

The crop was threshed with Reeves rice separator, by Jacob Branstine & Son. The crop, "paddy rice," was sold to Goldsboro Rice Milling Co. of Goldsboro, N. C. at from 60c per bushel (the price for same damaged by storm) to $1.00 per bushel f. o. b. Lonoke.

HISTORY.

It has been claimed that rice is the only grain that produces the "one-hundredfold of the Scriptures." But this is not strictly true, for wheat and oats, under very favorable conditions, have been known to produce one hundred bushels to the acre. A legend has it that wheat and oats once thrived in water; that they were finally adapted to upland culture by migration and other influences of man.

The amount of plant nutrition in a rice grain is enormous. The plant "stools" very freely, producing 10 to 100 straws from a single seed and from 100 to 400 grains from a single head.

FOOD VALUE.

Rice is said to be the staple article of food for about one-half the population of the entire earth. In the densely populated countries, China, Japan, India and the West Indies, rice with leguminous crops, peas, beans, etc., furnishes a complete ration. In rice-growing countries of the Orient, rice is eaten as a substitute for Irish potatoes and wheat bread. In China, Japan and Java, soy beans and soy bean cheese furnish with rice a complete ration. In the United States it is served as boiled rice, flaked rice, puffed rice, and in many other well-known dishes, all of which give variety to diet. It is easily digested and highly nutritious, especially as the Orientals serve it without the high polish the American trade demands. Boiled rice is said to digest in one hour. In countries where rice is the chief article of food indigestion and stomach troubles are of rare occurrence. It can be cooked with the crudest utensils and under all conditions is a health diet.

Analyses show that 100 pounds of cleaned rice contained 87.7 pounds of nutrients, as follows: protein, 8 lbs.; fats, .3 lbs.; carbohydrates, 79 lbs.; ash .4 lbs.[1] By way of comparison, wheat flour contains 87.2 lbs. of nutrients; protein, 10.8 lbs.; fats, .1 lb.; carbohydrates, 74.8 lbs.

Rice polish, or the flour obtained from rice in the process of milling, which can be bought at the mills at about 3/4 cent per pound, will doubtless be in demand for food when its value is appreciated. It contains 10.4% protein while clean rice contains but 7.4%. It is a matter of regret that fashion and looks demand that our rice be polished to a bright lustre, reducing materially the food value. Travelers tell us that rice eaten abroad is far superior to American rice in flavor and nutriment.

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[1] U. S. Dept. of Agr.

SUGGESTIONS.

SOIL REQUIRED.

It is known that rice will thrive on many different kinds of soil. It can probably be grown on any of the soils of southern Arkansas that can be successfully irrigated. It will not thrive in a dry climate or at a very high altitude. The best soil for rice is the medium loam with a large per cent of clay. This will permit of enough humus for a high degree of fertility and still be sufficiently compact for the rice plant. Experience has shown that rice does not grow well where there is too much humus or where the land is too porous and light. It requires a clay or retentive subsoil to prevent too rapid percolation and evaporation of water. For this reason sandy or gravelly soils, unless underlaid with clay or other impervious sub-soil, are not recommended for rice because of the difficulty of flooding.

The Prairie Longue and Grand Prairie regions of Arkansas are especially adapted to rice culture. The low, level character of the land, the stiff texture and impervious sub-soil, are peculiarly favorable to holding water during irrigation, thus economizing the amount necessary. The ground dries immediately after the water has been turned off so the binder and team will pass over it. An abundant supply of pure water can be secured from wells ranging in depth from 100 to 200 feet. The geological formation is such that the lift is not usually more than from twenty to forty feet. Delta lands of the Mississippi and those of the rivers of the Carolinas and Georgia, produce a fine grade of rice which reaches the market early and brings fancy prices. However, in many cases these lands are not adapted to the use of the improved machinery, consequently the expense of growing the crop is greater than that of the prairie lands.

The alluvial lands of south Arkansas are in many places adapted to rice culture. Pure warm water, with nitrates and other soluble plant food, can be taken from lakes, ponds, bayous and rivers at very little expense.

Capt. W. P. Dorch of Scott, Ark., planted forty acres of bottom land lying adjacent to Bearskin Lake. His object was to determine whether irrigation would kill nut grass, so abundant in the field, and at the same time produce a crop of rice. The experiment was a success. The yield of the rice crop was an average of 46-1/2 bushels to the acre.

Mr. M. L. Walt, of Lonoke, grew a crop of rice on his bottom farm near the farm of Capt. Dorch.

LEVEES.

The best time to build levees is in the early fall before the winter rains and freezes. In the prairie region where the land is so nearly level, levees are neither difficult nor expensive. The well must of course be situated on the highest elevation of the field to be irrigated, and canals and levees should be built in accord with the natural drainage. The outside levees must be broad and secure against leakage, seepage and spring freshets. The land where the levees are to be built must be plowed, harrowed and thoroughly pulverized as if it were to be planted to a crop. It is best to throw out a ditch 12 to 18 inches deep and 2 to 3 feet wide as a foundation for the levee, tramping the bottom firmly with men and horses. Then throw the dirt into the ditch with the plow, keeping it tramped after the plow. When above the level the earth may be heaped by extending the mold board of the plow and by a wooden frame made in the shape of the letter V. Levee builders very often take the place of the latter tool. The height of the levees will depend upon the general slope and size of the field to be irrigated. It may be said that the field should not be too large. The proper depth of the water may be regulated by cross levees. It is desirable that the entire field ripen uniformly as nearly as possible, hence the levee should be so arranged that the depth of the water will not vary materially. Without a leveling instrument is it sometimes difficult to determine where the cross levees should be built. Where mistakes have been made or where other cross levees are needed after the water has been turned on the field, the plowman in rubber boots can usually take his team and make the correction with safety. Cross levees are always temporary and may need to be changed every year, hence from two to four furrows with breaking plow is sufficient for them.

DRAINAGE.

Drainage is a very important factor in rice growing. Experience has shown that in order to save the crop in good condition the water must be removed as soon as possible after the grain is ready for harvest. The tall grain shades the land so thoroughly that evaporation is extremely light; hence if the drainage is poor and the water is left in holes and corners, it evaporates very slowly. Many entire crops are lost as a result of improper drainage. Good drainage is more essential for rice than for some other crops, because irrigation always results in the accumulation of alkali salts on the surface of the soil, which when remaining in large quantities is very detrimental to the crop. The only way to avoid this is by deep plowing and good drainage. Where the fields have good drains the alkali salts are carried off with the water and the air and sunshine soon start microorganisms at their important work of nitrification.

The commercial value of rice demands that it be cut in the proper stage and cured in the proper manner. This cannot be done with poor drainage.

PREPARATION OF THE SOIL.

Although rice is a shallow feeder it by no means follows that shallow plowing is best, as was formerly believed. While it is true that rice stubble is very heavy on a team, the roots very tough, and the plowed land usually very cloddy, it is believed that the land should be plowed deep, expecially after a crop has been harvested from the land. Rice responds to good culture as readily as corn or wheat, and inasmuch as the cultivation of rice must be done before the crop is planted, it is necessary to have the ground in good tilth. The disc, the roller and the smoothing harrow are indispensable to the rice grower. The grower will find that it pays to put the land in good tilth before seeding.

FERTILIZERS.

There is little information on the subject of fertilizers for rice. Some experiments in this line will be made next season and the results published. Rice is not a particularly great impoverisher of the soil, especially when the stubble is turned in the fall and the straw returned to the soil. The Texas Experiment Station estimates that in an average crop of rice the straw is 59%, the rough rice 41%. Assuming that the average crop for Arkansas is 1500 lbs. to the acre, which is about the average for the crop of 1906; estimating the straw at 60%, the rough rice at 40%, we have:

	Phosphate	Nitrogen	Potash	Worth
1500 lbs. rough rice removes........	9.1	18	3.97	$3.62
3000 lbs. straw stubble removes.....	4.26	19.37	49.11	3.87
300 lbs. lint cotton removes........	9	22	9	2.51
300 bushels oats removes..........	37	27	9	6.99
20 bushels of corn removes.......	30	30	10	7.10

According to our figures it will be seen that to return the straw and turn under the stubble the rice crop of one acre would involve a loss of only $3.62 in fertility elements, estimating the price of nitrogen at 16c per pound, phosphoric acid 6c, and potash 5c, which is about the average. It may be stated further, that from the table 300 lbs. lint cotton removes $2.51 worth of plant food, 300 bushels of oats $6.99; and 20 bushels of corn $7.10.

But growing rice on the same land year after year, removing the straw, and as some now practice, leaving the stubble until spring, will impoverish the soil and unless rotation of crops and fertilization is practiced the yield will greatly diminish.

The difficulty in getting the full benefit of fertilizers for rice lies in the fact that the process of nitrification cannot take place in a badly drained and flooded field, hence nitrogen in fertilizers containing organic nitrogen, as cotton seed meal, tankage, dried blood, barnyard manure, etc., cannot be converted into nitrates under such conditions. To get the full benefit of fertilizers the soil must have sufficient humus, aeration and warmth to accelerate the action of soil micro-organisms. These organisms cannot exist in an acid, cold and badly drained soil.

Where water is taken from rivers, lakes, ponds and bayous, much soluble plant food is deposited on the surface of the soil in the form of silt. Under such circumstances the fertility of the soil could be maintained for a considerable length of time without fertilization. This of course is not the case where irrigation is from wells of practically pure water.

In Japan, and some portions of the United States, rice lands are fertilized and the yield thereby greatly increased.

VARIETIES.

Since the cultivation of rice began a great many varieties, differing in size of grain, color, quality for milling purposes, and length of time for maturity, have been developed. The two general classes of rice are "gold seed," so-called from the color of the husk, and the "white rice" which was first introduced into South Carolina from Madagascar, 1694. The "gold seed" must not be confused with red rice, (*Oriza sativa rufipogon*), which will be describer later. The gold seed is famous for quality and yield. The "upland" variety, which is in appearance very similar to Honduras rice, has been adapted to upland culture, and produces a crop with little or no irrigation. However, the yield is not large and the milling quality poor. When planted on lowlands and irrigated it is about equal to the Honduras. The Honduras and Japan are the only varieties at present planted in Arkansas. Both varieties have merit, and objections. The Honduras is a longer grain, takes luster in polish, consequently commands a better price in the market. The Japan, "Kiushu," lately imported from that country by the United States Department of Agriculture, is usually very productive. It is earlier than Honduras and is especially recommended where late planting is necessary. It usually fills better than the Honduras. The stalks are small, hence it usually suffers more from storms. The grains are oval, heavy; they stand milling well, but the market price is somewhat less than Honduras.

PLOWING AND SOWING.

Land for rice should be prepared as for other cereal crops by deep plowing and fall and winter fallowing. In the spring it should be rebroken, disced, cross-disced, followed by the roller and smoothing harrow. The seed may then be sown with a grain drill or broadcast by hand. The grain drill with disc attachments is preferable as it gives the ground another working, sows the seed uniformly and same depth. It is important to have the seed germinate as nearly as possible at the same time so the entire field can be harvested in the proper stage. Experience has shown that rice should be planted as early as the season will permit after all danger of frost is over and the temperature of the ground will germinate the seed. The planting season is usually from April 1, to May 15. Many growers plant at different periods, giving an opportunity to harvest each field at the proper stage and to avoid the danger of loss by storm. The early sowing generally escapes the "showery season" so fatal to pollination, while the stigmas of the pistils are receptive, and is usually harvested before the period of rains and storms about equinox. Much loss has been sustained this season to the late sowing because of heavy rains. There was also much "light rice" as result of showers during period of pollination.

The Japan as before stated is better adapted to late sowing than Honduras, and may be sown any time till May 15. Some seasons even later.

IRRIGATION.

That an abundant supply of water for irrigation is essential for a rice crop goes without saying. No rice grower should purchase machinery or plant a crop of rice until his water supply is assured. Many growers who had trouble during the spring of 1906 will acknowledge the wisdom of this suggestion. There is always some risk connected with getting a good well. For this reason no attempt should be made to plant till water is assured. There is usually enough moisture in the soil during early spring to germinate the seed, but if there should be a drouth the land may be flooded just after planting to insure a good stand. In that event the water should be withdrawn as soon as seed sprout to prevent the young plants from scalding. Irrigation begins when the plants are from six to eight inches high and before weeds have a chance to crowd out the young plants. The depth that the water should stand upon the field will depend upon the weather and condition of the crop. If the land is free from weeds and grass it is only necessary that the ground be kept wet, but if weeds and grass are numerous the ground should be kept covered with water till they are killed and the rice shades the land. Ordinarily it is better to draw the water off a few days after flooding for the plants require sunshine and air as well as water. Maturity will be somewhat retarded where the water stands too deep on the land. It is therefore important to have the water on the field as nearly the same depth as possible to insure uniform ripening.

The length of the irrigation period varies from 70 to 100 days according to condition of the crop and the weather. When the heads begin to turn yellow and droop, it is time to withdraw the water. If the land is not well drained the water may be drawn off earlier so that the grains will not shatter and become too brittle.

WEEDS.

A few days of hot weather on weeds not aquatic, is usually sufficient to kill them. A few are aquatic and thrive as well in water as rice. Red rice, *Oriza sativa rufipogon,* has made its appearance in the fields. It is a matter of great importance that the habits of this plant be understood and that it be eradicated before it becomes thoroughly established in the fields. Many fields in Louisiana and Texas have recently become so badly contaminated with this weed that the crop is unsalable, and in some cases the fields have been abandoned. Red rice is just as nutritious as the white varieties, and its damaging effect lies in the fact that the red is very soft and breaks in the process of milling. Hence a few grains of red in a bag of rice greatly reduce the market value. Red rice is so called from the color of the grain. The grain is usually a dark red though all shades from pink to deep red may be found. Sometimes the outer seed coat contains the coloring matter, then the red may be polished off in milling. In comparing the red variety with Honduras we note the following difference: The panicles of the red are longer; the heads more branched; the grains smaller, fewer, and scattered on the head. The heads are lighter than those of the Honduras, and as the stalks are not so tall, do not droop as the Honduras. The branches of the panicles of the red are arranged in a whorl. The grains being on short peduncles. The Honduras grains are borne on longer peduncles. There seems to be little doubt that red rice is a distinct variety, while some botanists consider it a different species from the white. Obviously, therefore, the seed of one variety cannot produce the seed of the other. Many growers believe that white seed left on the ground during the winter will produce red rice the following spring. Some account for its rapid increase in this way. Others think that young plants of the white kind when injured sometimes produce red rice. The error of these conclusions has been determined beyond a reasonable doubt.[1]

That the two varieties may and often do cross if near each other, there seems to be little room for doubt. The light pink grains with coloring in outer coat are probably the result of cross-fertilization, and as the primitive red is stronger and more persistent the cross-fertilized progeny would have a greater tendency to assume the character of the red. If it is true that it will mix with the white, and there is little room for doubt, the rapid increase of this pest is explained. The red not only ripens its crop without diversion, but fertilizes some of the white, thus propagating the red species. To make the meaning clear, we quote from Prof. Dodson, La. Expt. Station, Bul. 50:

"Suppose a single seed of rice finds its way into the field this will produce a plant that will ripen seed that will be carried over the winter and produce other plants of its kind. Also, when the plant is in blossom some of the pollen from its flowers is blown to a plant of the white seed. This will show in the seed produced, which will have some of the characters of both parent plants. Now, if this seed be shattered from the head it will have a greater power to survive the winter than the white seed. If we consider the second crop, there is no reason why some of the seed should not survive. They produce other plants, some of the seed of which will revert to the red form, some to the white form of parents. The white is likely to dry out and the red is likely to have a good number of seed survive, thus increasing the amount of stock independent of the original direct offspring."

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[1] Louisiana Expt. Sta., Bul. 50.

The theory held by some that red rice will remain in the soil two or three years and then germinate, Prof. Dodson thinks erroneous. He was unable to keep seed in moist soil over spring. It is believed that if no plants were allowed to produce seed the first year after the field had been planted to some other crop, that one year would suffice to kill the red rice. This matter will be investigated. Prof. Dodson observes[1] that the white stems usually when left standing in the field decay at the nodes and the heads fall to the ground in late fall or early winter; but that the stems of the red do not decay so readily. The straw of the latter becomes over ripe and weakens just above the first node below the head, sometimes in the second internode. As a result of this the head falls over and remains suspended above the ground. In this way, while many grains are of course shattered and destroyed by birds and animals, a number remain dry and are preserved till after winter germination. This is in accord with our own observation. As a result of nature's clear device for propagating the species the fields are re-seeded in the spring and the increase is therefore enormous.

REMEDY AGAINST RED RICE.

Every precaution should be used to keep red rice seed from the fields. The grower should see that his seed is absolutely free from red rice or other noxious weed seeds. It is a good plan to have a few acres isolated and planted on sod or new land, for seed. The second year the seed may be selected by going over the field before harvest with reap hook and gathering the largest, earliest and best heads for the next crop. It would require but little time to select and thresh by hand enough seed to plant an acre or two. This will produce the seed for the following year. In this way red rice would not only be kept from the fields, but an earlier and otherwise superior variety could be bred. When red rice is first discovered the field should be plowed, disced and harrowed just as soon as the crop is harvested. If the land is dry and hard it may be flooded. This will germinate many seed which will be killed by the winter freezes. There will doubtless be other seed germinate in the early spring, but the spring plowing will kill such. The levees and ditches should be carefully watched for any suspicious weed. They should be mowed occasionally to prevent red rice from seeding. The progressive rice planter will walk over the fields with water-proof boots occasionally about the time the crop begins to head, and if there is a suspicious plant destroy it. It is sometimes necessary where red rice has a firm hold in the field, to plant land to rye, vetch, clover or oats. If the land is sufficiently drained a cultivated crop such as cotton, corn, sorghum or cowpeas, may be planted. The rotation, oats in the fall followed by cowpeas, will greatly improve the land, and at the same time destroy red rice. Should the land be too low (water logged) and acid, to produce other crops, it may be plowed in the fall as recommended above; lie fallow till spring, plowed again, lie fallow till mid-summer and plowed again. Red rice is very persistent, but heroic treatment as recommended will destroy it.

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[1] Louisiana Expt. Sta., Bul. 50.

HARVEST.

The grain should be cut in the "dough" stage; shocked on dry land and allowed to cure in the shock. When cut before it is full ripe the grains shrink slightly and become tough, hence stand the process of hulling much better. Besides, it adds to the flavor of the rice to cut in the "dough" stage.

McCormick and the Deering Ideal, made with broad wheels and lugs especially for rice lands, are used to cut the grain. As the ground is usually wet it requires from four to six horses to draw the machine. Just enough straw is cut with the head to allow the machine to bind regular. Great pains must be taken to shock the grain securely against rains and storms. The heads should be sheltered with caps to prevent "sun-cracked" grains and protect it as far as possible from depredation of birds. Two hands, by working together, can shock faster and better than where each works alone. It is shocked the same as wheat or oats, keeping the heads well pressed in.

Cap the shocks securely, letting the heads of the caps to the north side where there will be a minimum amount of sun-cracked kernels.

THRESHING.

If the weather is favorable eight or ten days is long enough for the grain to cure in the shock. No experiments have been made in stacking the grain. It is believed that where a thresher can be had at a seasonable time, and where the shocking has been properly done, nothing would be gained by stacking. The rice is hauled directly from the shock to the thresher. The rough rice is put into sacks, loaded to cars and shipped. There is need of a more economical way of handling rice. Sacks are expensive, and where the grain is put into sacks two or three hands more are required at the machine. The price received for ''paddy'' or rough rice varies like the market of other crops. It usually brings $2.60 to $4.30 a barrel of 162 pounds or from 60 cents to $1.00 per bushel.

BY-PRODUCTS.

Rice straw is said to make a good grade of paper. When cut and cured in dry weather rice straw makes feed almost equal to our southern prairie hay. As yet there has been little market for it. The straw from the Japan variety is especially good, being small and remaining green till harvested. Rice straw contains crude protein 4.72 per cent; carbohydrates 32.21 per cent; fats 1.87 per cent.[1] Where it can be fed to stock the manure should be returned to the land. If this is not possible, the straw itself scattered on the land and turned under will help maintain the fertility of the soil.

Rice hulls have sharp ends, contain silica, and in large quantities are not recommended for feed. There is evidence that hulls alone irritate the stomach of stock. Mixed with other feed they may be fed with safety. Hulls have some value as a fertilizer. They make a splendid mulch for gardens and orchards. While slowly available for plant food, they increase the porosity of stiff soils and furnish humus. Hulls are sometimes used for fuel and the ashes applied as fertilizer. The following table gives the analysis of hulls, polish and bran in comparison with other products.[2]

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[1] U. S. Dept. Agr.
[2] Tex. Expt. Sta.

	Water	Fat	Protein	Crude Fibre	Nitrogen, Free, Ex.	Ash
Rice hulls	8.62	1.12	3.07	36.17	34.66	15.38
Corn stover...	40.1	1.1	3.8	19.7	31.9	3.4
Timothy hay...	13.2	2.5	5.9	29.	45.	4.4
Wheat straw..	9.6	1.3	3.4	38.1	43.4	4.2
Oat straw	9.2	2.3	4.	37.	42.4	5.1
Rice polish ...	10.77	6.98	11.86	3.31	62.22	4.86
Bran	9.77	10.48	11.85	12.19	45.76	9.95
Corn	10.9	5.4	10.5	2.1	69.6	1.5
Oats	11.	5.	11.8	9.5	59.7	3.
Cowpeas	14.8	1.4	20.8	4.1	55.7	3.2
Wheat bran...	11.9	4.	15.4	9.	53.9	5.8

CENTRIFUGAL PUMPS.

The following table will serve as a basis to calculate the capacity of centrifugal pumps and machinery necessary to irrigate a rice field:

DUTY OF CENTRIFUGAL PUMP FOR IRRIGATING, LIFTING WATER LESS THAN 35 FEET.[1]

Diam. Discharge (Inches)	Discharge per Minute (Gallons)	Power for Every Foot of Lift (Horse Power)	Quantity Pumped per day (Feet per Acre)	Area Irrigated in 70 Days (Acres)
4	433	.27	1.87	60
6	1025	.56	4.53	158
8	1900	.98	8.39	294
10	3000	1.54	13.25	464
12	4275	2.06	18.89	661
15	7000	3.34	30.93	1083
18	10000	4.62	44.19	1547
20	13000	5.68	57.45	2011

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[1] Bond, U. S. Dept. Agr.

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Spraying Notes and Suggestions for Combatting Crop Pests.

By Ernest Walker.

At no time in the history of Arkansas' horticulture has there been exhibited on the part of practical fruit growers, and others, as great an interest in methods of combatting insect and fungus enemies of crops as is being shown at the present time. The advent of this encouraging state has been slow, and is largely a matter of the past few years. Spraying and related orchard methods have received a vast amount of attention at the Experiment Stations; but it has been difficult to awaken practical growers as a class to the necessity of adopting these improved methods, as practical matters. Here and there one of the more progressive growers was led to put into practice the suggestions of the Experiment Stations, but frequently with only unsatisfactory results. Neighboring growers watched the outcome. In many cases instead of advancing the cause of improved methods in orcharding, the result of imperfect efforts was to retard progress. Instead of being a demonstration of the efficiency of spraying, and related methods, these cases seemed to show its inefficiency. The little interest that had been awakened, at once died, and we heard of some such disappointed advocates falling back upon their old methods of *laisser fairé,* and both by example and precept teaching their neighbors that these new departures were only theory—impractical. In some instances influential men of this type not realizing the responsibility they had assumed, have been blamable to a considerable degree for the backwardness of their entire neighborhood,—teaching that the only safe road to profits in orcharding is to "spend little or nothing on the orchard." One would think that any sort of man, no matter how little his education might have been, would be proof against such teaching. Nevertheless, such seeds found receptive soil in many a neighborhood; with the result that these neighborhoods settled down to helpless acquiescence in "off years," wormy, scabby fruit, unpruned trees, and starved orchards, old and young.

Inquiry reveals the fact that these "set backs" to spraying were due to a variety of causes having their sources in the growers' mistakes, or failure to thoroughly master instructions concerning the work undertaken. The following are some of the sources of unsatisfactory experience:

(1) No agitator on pump; (2) poor nozzles—throwing a shower instead of a mist; (3) insufficient and variable pressure; (4) lack of thoroughness; (5) failure to do the work at the right time on account of unfavorable weather; (6) use of wrong materials for the pest being fought; (7) use of impure materials; (8) improper mixing of ingredients; (9) neglect of later sprayings; (10) too large orchards for the spraying facilities; (11) interference of winds or rains with timely and thorough work; (12) expecting spraying to compensate for neglect of the usual good care, of which spraying is only one feature.

At last however, the fogs are lifting and the prospect is more cheerful. The grower has been waiting. He has not wanted to take up the laborious work of spraying unless compelled to. He has often been inclined to regard it as theory—successful possibly on a few trees, but hardly worth the trouble in large orchards. He has often been inclined to consider the loss of a certain part of his crop less expensive than the labor of trying to save it. Lastly, he has been inclined to regard spraying as a rather difficult matter—a thing perhaps all right for the scientific man, but too uncertain for the man who is not well posted on chemistry, fungi, and all kinds of insects. In consequence he has never applied to his State Experiment Station for the bulletins or advice, which would have made the matter plain and have served to set his ideas right in regard to the value of education applied to the every day affairs of life.

The years 1902-3-4 and 1905 were "off years" in Arkansas apple orchards. The last was not wholly such, but one of a light crop here and elsewhere. In 1903 a late spring freeze was the cause of the fruit failure. The others were just "off years." Four such years in succession were hard on the growers and the public too. It had the effect of causing growers to question the orchard policy they had been following, and particularly when in 1905 they found that in spite of the "off year" some orchardists had good crops and fine apples. The horticultural press gave accounts of splendid results in a number of commercial orchards in several different states. These results attracted more than the usual amount of attention on account of the contrary experience of the average growers during the same, and preceding years. These successful results were found in orchards where the owner was spraying and following other up-to-date methods which year after year the various Experiment Stations had been advocating.

Similarly successful results on a commercial scale for the year 1905 were obtained in an orchard under the management of the writer, and published in Bulletin 91 of the Arkansas Station. The contrast between results in sprayed and otherwise well cared for orchards in that year was so marked in comparison with those in unsprayed orchards, that a tremendous interest was aroused. As a result, a great many spraying outfits were purchased by Arkansas growers, in 1906. Besides the several types of barrel rigs a number of power sprayers were purchased. At present there are doubtless more power spraying rigs in Arkansas than there were barrel pumps in the state in 1900.

Peach growers southward have hitherto given no attention as a rule to spraying; but they are now taking up the matter and the large orchardists are purchasing power sprayers. Peach orchards yield well for a few years on the worn cotton soils without fertilizers, spraying, or especially skillful care. Then they begin to show the need of better care. In a trip through the peach section last summer, orchards everywhere showed the need of fertilization and better care generally, and the need of humus forming crops, like cowpeas, or other legumes.[1] The trees as a rule, also showed serious injury by "shot-hole fungus," while the curculio has been causing heavy losses. The brown-rot, or "twig-blight," did much damage last year, while "peach-leaf curl" is rather abundant some seasons. These matters are beginning to compel attention.

Just now there is an increased interest in the matter of spraying, owing to the presence of San Jose scale in a few of our peach and apple orchards, and city yards. Were a careful survey made it is probable that the scale would be found to be present in other places, and more abundantly than our people are aware. The presence of this greatest of insect orchard pests may well awaken interest. For although it can be kept from doing great damage and held in check by the lime and sulphur spray, it behooves us to be about the business to prevent the damage which will inevitably result if this pest is allowed to multiply unchecked.

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[1] Suggestions along these lines were given in Bulletin 79, Arkansas Experiment Station, entitled "Peach Growing in Arkansas."

It is a pest which is more rapidly injurious to peach trees than to apple. It will kill a peach tree in about three years. It is capable of spreading rapidly and during the past season or two seems to be making rapid headway in several states. Growers should be on the look out for it and promptly send samples of the bark of trees which appear suspicious, to the Entomologist of the Arkansas Experiment Station. The present Nursery Inspection Law of Arkansas passed in 1903, is not adequate. Provision should be made for compulsory inspection of all nurseries in the state, and for orchard inspection. The State Horticultural Society and the Experiment Station are urging the passage of such a bill.

On the whole, the outlook for Arkansas fruit growing is better than it has been. We are awaking from our dreams of vast orchards of perfect fruit and great crops without other care than that incident to harvesting and counting money, and we are sanely considering the proposition of small areas well cared for where we can enjoy the fun of doing things instead of leaving them to do themselves. Could we do so more often than we do there is no real satisfaction in reaping where we have not sown,—but the bread of our own hands is sweet. To be content with what nature sends is to be a mendicant—a gleaner of crumbs when it is our privilege to be lord and master at the feast.

SPRAYING RESULTS IN 1906.

Bulletin 91 of this Station gave results of spraying and other improved practices as applied to apple growing in a commercial orchard. The fundamental facts underlying the practice of spraying were discussed, and formulas given suited to the needs of the apple grower.

Here will be given results obtained the past season, together with suggestions and formulas relating to other crops. The general awakening along these lines has resulted in a great increase in the number of letters seeking such information and advice.

The orchard in which the spraying was done was the apple orchard reported upon in bulletin 91, embracing two thousand bearing trees, or about twenty-seven acres—the actual area in orchard represented. The orchard had a light pruning last winter, and fair cultivation. Each bearing tree last spring received six pounds of a fertilizer,—a few trees on poorer ground received further small applications of stable manure. Rye was used as a cover crop in nearly all the orchard, except two of the poorer portions which were sown to crimson clover. The commercial fertilizer furnished:

Nitrogen, 2 per cent,
Phosphoric acid 6-7 per cent,
Potash, 10-12 per cent.

This was applied broadcast in the middles and worked into the soil by means of a cutaway disc and smoothing harrow. The application amounted to 450 pounds to the acre, and furnished:

Nitrogen, 9 pounds,
Phosphoric acid, 27 pounds,
Potassium, 45 pounds.

This was a light application. Double the amount could well have been given. The last year's application will be duplicated this spring,—when the ground will be plowed three to four inches deep to place the unsoluble portion down where it should be.

The mixing of ingredients for spraying was done from stock preparation, such as usually recommended. An elevated platform for the mixing tank was constructed similar to that described further on in this bulletin. A "Friend" gasolene sprayer was used, wide-tired wheels, 200 gallon tank, and two runs of hose 25 and 50 feet, pressure of 140 pounds, provided with extension rods and cluster nozzles of the vermorel type. Most of the time the men worked on the ground, but the height of some trees made it necessary in part of the orchard, for one of the men to stand on the platform, three feet high above the tank.

The 4-4-50 formula for Bordeaux was used. The arsenite used was "disparene" (arsenate of lead). Three pounds to fifty gallons of Bordeaux were used. The disparene was first carefully worked over with water and thinned till about like milk, and was then poured into the Bordeaux mixture while working the agitator on the mixing tank. A part of the orchard received three sprayings, a part four, and another portion five, as follows:

Part 1.	Spraying	1—Bordeaux, as buds expanded.
	"	2—Bordeaux containing arsenite, after petals fell.
	"	3—Bordeaux after finishing No. 2.
Part 2.	"	4—Bordeaux two weeks later. Earlier sprayings as above.
Part 3.	"	5—Bordeaux with arsenite July 15th. Earlier sprayings as above.

The general results for the orchard were 2185 barrels of No. 1 apples and 258-1/2 barrels of culls in all; or slightly less than 90 per cent. of barreling apples.

The part sprayed three times was in fine condition till about gathering time. It was showing as good results as the part sprayed four times, until shortly before gathering the apples. Then the bitter rot started in this part of the orchard, and while the attack was not severe it spotted a good many of the finest apples. These were closely culled out, increasing the culls from five to twenty-one per cent for this part of the orchard. The bitter-rot affected a few apples in the part sprayed four times, but there was barely a touch of it on a few trees. This part showed only five per cent culls. The part sprayed five times—the last July 15, had not an apple touched by bitter rot, and showed the largest percentage of perfect apples, the crop being almost perfect—only two per cent of culls.

Bitter rot was responsible for the larger part of the cull apples in the orchard, although on the whole the season was only moderately favorable for its development; being rather too cool, though moist.

Scab was almost absent in the orchard. There were touches of the "star fungus" (Phyllosticta sp.) but only little serious damage. Codling-moth damage was very slight. The curculio likewise did but very little damage. In other unsprayed orchards near by the "star fungus" did great damage, and the codling moth became more and more serious as the season advanced. The curculio damage was also plentiful in most orchards.

Disparene has given much better results than Paris green this season in this vicinity.

Other sprayed orchards in which the arsenite used was Paris green after petals dropped showed good results till late in the season (August), when there was severe damage by the late brood of codling moth, and some damage as a rule by bitter rot. The apparent explanation of this late damage by codling moth in these orchards is that the frequent rains during the summer washed away the Paris green, while proximity of nearby unsprayed orchards furnished a large late brood of the insect.

Disparene as is well known, adheres better and is more lasting in its effects than Paris green or the other usual arsenites. But part of the good results shown may have been due in part to the fact that all fallen and decaying apples were removed from the orchard the preceding fall, while of two neighbors' orchards of bearing trees, one was sprayed and the other had only a small crop.

In an unsprayed orchard situated on similar soil in the neighborhood of the orchard for which results are given above, the codling-moth, bitter rot and "star fungus" damage was found to be 60 per cent, not counting "wind falls;" so that a large crop on twenty-five acres yielded less than 500 barrels. At $1.00 per barrel the loss would have purchased a power rig and paid the cost of spraying the orchard two seasons. Another orchard of similar size, but poorly cared for year after year, had many trees which did not bloom when generally in orchards the bloom was unusually heavy. This orchard did not produce a barrel of really good apples.

Several parties heard from, who sprayed their orchards were greatly pleased with their results the past season, and are preparing for more thorough spraying the coming season. Others who have not been spraying have stated that they will provide themselves with power sprayers the coming season.

GENERAL SUGGESTIONS ON COMBATTING INSECT AND FUNGUS ENEMIES.[1]

Conditions surrounding the agriculturist today are very different from those of a generation ago. They are more complex. As a rule the farmer or horticulturist must be a better "posted" man in his particular line than formerly. To be this he must confine his attention to a few crops and know them thoroughly, and as a rule, he should cultivate thoroughly smaller areas rather than large areas badly. Worn soils in comparison with the virgin soils of pioneer days, resulting from unwise farming, is one of the factors necessitating the more intensive methods required today. Intimate knowledge of any crop today includes a degree of familiarity with the more important insect enemies and fungus diseases to which such crops are liable, together with the means of cheaply combatting them.

A great increase in the numbers and depredations of insect pests and plant diseases is incidental to the disturbing influences of advancing civilization and to the extension of areas devoted to special crops. Insects may abandon their wild food plants and develop a fondness for related introduced species in cultivation. The species which previously was considered harmless may thus become a great pest. Under pioneer conditions abundance was easily produced and commonly the market value of ordinary farm products low. Insect damages unless very extensive indeed, awakened in early days comparatively little concern,—plenty any how. The grower expected it, and so long has he expected it, that even under the changed conditions of today he frequently continues to expect it as an inevitable and unavoidable part of his labor. But as far as many pests are concerned there is no need of expecting it. That a large part of the damage done by insects and fungi can be prevented at a comparatively small cost has been settled, and in most sections of the country intelligent growers consider warfare on crop pests as much a part of production, as tillage, or the preparation of the land for crops.

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[1] Consult also bulletin 91 of this station for a discussion of the fundamental principles of spraying.

The term spraying in its restricted sense means the application of poisonous or fungicidal liquids or powders to plants in the form of a mist or cloud-like spray for the purpose of preventing attack by injurious organisms or to destroy those already present. In a broader sense, however, the term may well be understood to include various other phases of warfare upon crop pests, such as destroying sources of infection, crop remnants, and other breeding places; maintenance of the vigor of crops by thorough cultivation; the use of manures and good care generally, since as is well known, thrifty plants not only suffer less when attacked, but are less liable to diseases and insect pests than those weakened by neglect. Wild plants frequently harbor the fungi or insects which trouble the crops being cultivated. The good grower seeks out and destroys such as exist in dangerous proximity to his crops. Rotation of crops is a means of starving out certain pests and is of great value in the case of short lived crops. Orchards being perennial, however, offer special opportunity for the increase and destructiveness of insect pests and plant diseases unless careful attention is given to the several means of holding them in check. Spraying alone, when properly done gives good results, but for the best success the term should always be associated in the mind of the grower with the several practices above mentioned. Spraying costs something. The above suggestions have in view diminishing the necessity for it, cheapening it, and increasing its efficiency.

Another general suggestion is the desirability of co-operation among the growers of a given locality in fighting their common enemies. The spores of fungi readily fly through the air and insect pests readily fly from place to place as a rule. So while one grower is waging commendable warfare upon crop pests and benefiting the neighborhood in various ways as well as in this, his less progressive or careless neighbor who adheres to the old ideas and refuses to spray may be maintaining a breeding place for the pests, which not only injure him but his good neighbor to some extent in spite of his industry.

Among those who have not fallen into line on the spray question there is still frequently met with a fear of poisons applied to fruits or other crops. Without going into detail on this matter which has long since been threshed over and settled, I will only say such fears are groundless when the ordinary spraying directions are followed, both as to humans eating the fruit or cattle eating grass under sprayed trees. With reference to arsenites the amount adhering to any individual fruit is exceedingly small; moreover, the rule is not to spray fruits with arsenical sprays within one month of the time of harvesting. In the use of vessels containing poisons, and in handling the poisons themselves, however, great care should be used. These should be kept out of the reach of children and marked or labelled distinctly. Vessels in which the arsenites have been mixed should be used for no other purpose.

The main thing when the need arises, is to spray. Know the life and habits of the insect or fungus and apply the remedy. Be in advance. Be prompt, persistent, thorough. Some diseases injure the foliage of fruiting plants, and as in the case of apple scab, by the injury done the foliage, and perhaps its premature shedding, reduce the next year's crop. In the case of such plants we should spray even when there is no fruit on hand to be protected.

Timeliness is often half the battle. Orchard spraying is not a thing that can be done at one time as well as another. If the ground is miry and you can't haul out a 200-gallon tank in the orchard, take out 25 gallons and box up the tires if necessary to give a tread of six or eight inches; but spray. If rains come, stop, but dodge in again as soon as they cease. Spray that has remained on trees two hours or has become dry will not need going over at once; otherwise the trees should be re-sprayed. Commonly, all that is required is to moisten all surfaces of stem, limb and leaves with the spray liquid. But in spraying for codling moth after the bloom has fallen, the object is to get a drop of the poison liquid in the throat of each blossom or on the bunch of stamens, and to accomplish this it will be necessary to spray until the trees begin to drip, and a somewhat coarser and swifter spray will be admissible. After about ten days the lobes of the flower cup of many varieties close together. It would then be too late to spray effectively for the spring brood of the "apple worm."

MACHINERY AND CONVENIENCES.

PUMPS.

For the sake of thoroughness and economy the operator should be provided with good appliances. The pump should be of brass or bronze practically in all parts coming in contact with the liquid. It should be simple and easily accessible in its parts. It should particularly, if a hand pump, give a high pressure—140 to 200 pounds—with a minimum expenditure of power. In capacity it should be suited to the extent of the orchard or area to be sprayed, or else more rigs will be needed to complete the spraying as promptly as required in spraying. If a small ineffectual pump be used it will be wasteful of material and time, and then prove unsatisfactory as to results, and tend to discourage the operator in spraying, and possibly his neighbor. Spraying is rather hard, disagreeable work at best, and the most up-to-date machinery should be secured to reduce the labor to a minimum, and make the work tell. The ordinary good barrel pump is sufficient for only about 1000 medium sized bearing apple trees. A list of dealers in spray pumps and materials will be found at the close of this bulletin—page 89.

A power spray pump should take care of three to six times the above mentioned number of trees, with the same number of men. Much depends on convenience of water and arrangements, size of trees and number to the acre. In one instance, an owner of a twenty-five acre apple orchard of good sized trees recommends two power sprayers for this amount of orchard. His reasons are, the work comes at a season when time is precious, and in addition work with the power sprayer is done so promptly that it is more effective. Either of these items could readily make a difference in the apple crop or other crops sufficient to pay the cost of the extra rig in a single season. *It is desirable that on every pump there be a pressure gauge to enable the man at the pump to maintain a constant pressure.*

AGITATOR.

An efficient agitator to keep the liquids well stirred during spraying is an indispensable part of every spraying equipment. See that it is there and see that it works.

CLEANING PUMP AND TANK.

Rains sometimes interrupt spraying and necessitate leaving the tank containing unused Bordeaux. If any of the submerged parts are iron they are attacked by the copper sulphate in the Bordeaux, and the iron suffers as well as the quality of the Bordeaux mixture. All such parts should be of brass or wood. Bordeaux mixture deteriorates with age anyhow, and it should be used the day made if possible. When to be left idle for some days the pumps and nozzles should be thoroughly cleaned by pumping clear water through them, and more important still is it that the pump and other parts should be thoroughly cleaned at the end of the season. Neglect of this may cause much inconvenience and loss. The lime and sulphur spray now so largely used against the San Jose scale is especially hard on the pump parts when the above precautions are neglected. In the case of the latter, it is a good plan to cleanse the pump after each day's use.

NOZZLES.

Numerous styles of nozzles have been made. The Vermorel or "Eddy-chamber type" however, is at the present time, used almost exclusively for ordinary spraying. Two to four such nozzles are mounted together at the end of an *extension rod* as a rule in extensive spraying operations. The spray is not thrown far,—but the extension rod, together with a platform on the wagon a few feet high enables the operator to effectually spray the upper parts of even tall trees. The "Bordeaux," "Boss," and "McGowan" nozzles are other types which are quite satisfactory, especially for certain kinds of work where coarser spray or greater force is required; or where it is necessary to throw the spray farther than ordinarily is required. For the usual spraying what is wanted is a fine steam-like spray and simply moistening the surfaces uniformly. Such a spray secures uniform and economical distribution. From two to four leads of hose may be supplied by a good pump. Two leads as a rule are preferable to four. The hose need not be over one-half inch. Each lead should be from twenty-five to fifty feet long. These lengths are desirable to enable the men to keep out of each other's way, and out of the spray in windy weather. Winds are frequently troublesome during the orchard spraying season. Hose should be of good quality to stand the high pressure required for the best work.

TANK.

The barrel pump may be mounted on a common 50-gallon barrel, but for a large number of trees a tank of 150 to 250 gallons capacity is desirable. From 150 to 250 gallons of liquid, depending on the condition of the soil, is as much as should commonly be hauled about. In case ground is wet and boggy only partially fill tank.

WAGONS.

Wagons with broad tires are desirable for spray-rigs, as frequently the ground is quite soft when spraying has to be done. The broad-tired, all-iron wheels, may now be had cheaply for any wagon from the manufacturers whose advertisements are found in most agricultural journals. Sometimes it may be necessary to box in the wheels in addition, to get through wet ground. Previous attention to surface or other drainage is sometimes called for and is desirable aside from spraying considerations.

FORMULAS.

FUNGICIDES.

Bordeaux Mixture.

Copper Sulphate (blue stone)	4 pounds.
Fresh Lime	4 pounds.
Water	40 to 50 gallons.

The formulas for Bordeaux mixture are varied somewhat for special reasons. The above however, has proved very satisfactory and is very largely used throughout the Mississippi Valley. Except when spraying dormant trees, there should always be a slight excess of lime in the mixture. Use well burned lump lime (not air slaked). Slake preferably with hot water in a water-tight vessel. Add the water gradually, keeping the lime wet, but not so rapidly as to chill or check the slaking. When slaked stir the mass, adding more water, and allow to stand for some hours covered with water before using.

Dissolve the copper sulphate in a separate (wooden or earthenware) vessel, by suspending it in a piece of gunny sack at the surface of the water. Preparatory to mixing, dilute the copper sulphate solution to 20 gallons. Stir the lime, adding water to make 20 gallons of thin white-wash. When thus diluted, pour the copper sulphate solution and the diluted lime together simultaneously through a strainer into a third vessel, stirring the combined liquid while pouring the liquids together. Add sufficient water to make 50 gallons. The resulting liquid is the standard fungus remedy, and is ready for use. Paris green, or Disparene (Arsenate of Lead), may be added to it as to so much water, if, chewing insects or their larvæ are to be dealt with, as well as fungi. This makes a combined fungicide and insecticide.

THE MIXING PLATFORM AND TANKS.

For the preparation of Bordeaux mixture for large orchards, there should be constructed a convenient place in the orchard, an elevated platform with a water supply at hand. This may be 7 1/2 or 8 ft. high. Upon it are placed the tanks to contain the separate lime and copper sulphate solutions. Some orchardists elevate these two tanks above a third tank upon the platform into which the liquids are run in mixing. This third tank is double the capacity of the other tanks. This tank may be dispensed with however, then it will be necessary or at least desirable to have the first mentioned tanks for the separate liquids larger. They should then be 100 to 125 gallons capacity each, depending upon the capacity of the wagon tank. In mixing, the separate diluted liquids are run simultaneously into the wagon tank through a strainer, working the agitator while so doing.

STOCK LIME.

For extensive spraying a large quantity of lime may be prepared at one time. For the purpose have a tight, flat box, six or eight feet long. Weigh out the lime in a multiple of four pounds, say 100 lbs. which is the quantity for 25 barrels of spray liquid. Slake the lime as above, spread out in a uniform layer of mortar-like paste and keep covered with water. The box may now be marked off in twenty-five sections. Lime for the stock preparation should be slaked some days in advance of the time when it is to be used, and kept covered with water so as to secure full and perfect slaking of all particles. The lime between two marks when carefully taken out, represents approximately four pounds of lime. This lime may be kept for weeks if kept covered with water.

STOCK SOLUTION OF COPPER SULPHATE.

In a fifty gallon barrel containing 40 gallons of water, suspend 40 pounds of copper sulphate. This gives a pound of the copper salt to each gallon of liquid. This preparation may be prepared in advance, adding water now and then to compensate for evaporation, keep it covered. Usually it is better to prepare the stock solution only a day or two in advance. The hoops of barrels are attacked by the copper solution and the barrels long filled are liable to burst or leak. It is to be borne in mind that the copper solution and lime must never be poured together until they have been diluted and when intended for immediate use.

For a 200-gallon tank, place 16 lbs. (four sections of the stock lime) in one of the 100 gallon tanks previously mentioned, add a little water and stir. When well stirred and mixed, add water to make 100 gallons. In the other tank pour 16 gallons of the stock solution of the copper sulphate and add water to make 100 gallons. Stir, then run the two liquids simultaneously through a strainer into the third vessel.

TEST FOR BORDEAUX MIXTURE.

Lime varies in strength according to the composition of the rock from which it is derived. It may contain a considerable percentage of magnesia. For this reason it is always desirable to test Bordeaux mixture especially when there is doubt about the quality of the lime. Five cents worth of ferrocyanide of potassium or yellow prussiate of potash dissolved in just enough water in a bottle to dissolve it, giving a concentrated solution, makes a reliable test for Bordeaux. Label the bottle POISON. A drop or two of this solution into a small amount of Bordeaux mixture in a saucer may show a reddish brown coagulation. This indicates the need of more lime in the Bordeaux. If there is no change of color the Bordeaux contains sufficient lime. If lime is added, test again. A bright knife blade dipped in the Bordeaux is also used sometimes for the same purpose. As long as there continues to be a deposit of metallic copper on the bright steel more lime must be added to the Bordeaux mixture.

STANDARD BORDEAUX MIXTURE.

The proportion of ingredients in what is known as the standard Bordeaux mixture, are

Copper sulphate	6 pounds.
Lime	4 “
Water to make	50 gallons.

This formula is too strong for peaches in leaf, and injures apples and pears sometimes by causing a russeting of the skin. It is well adapted to winter spraying, and its strength may be increased by reducing the amount of water used in making. The proportions, 6-4-20, are sometimes used.

WEAKER BORDEAUX MIXTURE.

Peaches in leaf are sensitive. The writer has used the 4-4-50 formula on them repeatedly without injury, but usually it is considered safer to use a weaker Bordeaux mixture. Waite, of the U. S. Department of Agriculture, gives the following as the most harmless formula to foliage:

Copper sulphate	3 pounds.
Lime	9 “
Water to make	50 gallons.

COPPER SULPHATE SOLUTION.

This should be used only on dormant trees:

Copper sulphate	3 pounds.
Water	45 gallons.

RESIN BORDEAUX MIXTURE.

Useful on plants to which ordinary Bordeaux mixture does not readily adhere. Asparagus is such a plant.

Resin	5 pounds.
Potash lye	1 pound.
Fish oil	1 pint.
Water	5 gallons.

Dissolve the resin in the oil, heat it in a kettle, cool somewhat and add the lye slowly stirring. Add the water and boil until the mixture will dissolve readily in cold water. Use in Bordeaux at the rate of two gallons to the barrel.

AMMONIA SOLUTION OF COPPER CARBONATE.

This material is not equal in fungicidal value to Bordeaux mixture but is sometimes used in late sprayings and at other times on account of leaving no stains, and the readiness with which it is washed off:

Copper carbonate	5 ounces.
Strong ammonia	3 pints.
Water	45 gallons.

Dissolve the copper in the ammonia using just sufficient to dissolve the copper carbonate. Agitate. Keep in a well stoppered vessel. For use, dilute with water in the ratio mentioned above.

DUST BORDEAUX MIXTURE.[1]

The manufacturers of dust spray machines are prepared to furnish dust mixtures ready for use. The addresses of some of these manufacturers are mentioned hereinafter.

The dust process of spraying is attractive but the grower should bear in mind that this method is still in an experimental stage, while the effectiveness of the liquid sprays when properly applied, has been established over and over by experiment stations and practical growers. It is to be hoped that the dust process or the formula will be so improved as to make it all that its best friends desire. Growers may well experiment with the dust, but as yet cannot afford to abandon liquid spraying for the dust process. The writer's own experience with the dust either homemade or purchased, has not thus far been such as to enable him to recommend it in a general way. It seems to possess considerable value against codling moth and other chewing insects as well as against aphis, but is not at all a dependable method thus far, against the usual fungus diseases nor against the San Jose scale.

POTASSIUM SULPHIDE SOLUTION.

Potassium sulphide	1 oz.
Water	2 gallons.

Potassium sulphide (sulphuret) is a yellowish deliquescent solid and should be kept in well stoppered bottles. It is very soluble. The solution loses its strength on standing, hence it should be made up as needed. The solution is valuable for surface mildews, such as that of the gooseberry, rose, and of the cherry, here. It leaves no stain and is non-poisonous. Sodium hyposulphite at the rate of 1/2 ounce to 10 gallons of water has been used by some for the same purposes as potassium sulphide.

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[1] If interested consult on the subject, among others, Bulletin 76, N. J. Agr. Exp. Sta., 1906; Farmers' Bulletin 243 U. S. Dept. Agr.; Bulletin 217, Cornell Agr. Exp. Sta.; Bulletin 111. Agr. Exp. Sta., Dust Spraying; Cir. 20, Mo. Agr. Exp. Sta.

CORROSIVE SUBLIMATE SOLUTION.

Corrosive sublimate	1 part by weight.
Water	1000 parts.

For small amounts tablets may be had at any drug store. A single tablet dissolved in one pint of water will make a solution approximately of the strength mentioned. Glass or similar vessels should be used. Larger amounts may be made by dissolving 2 ounces of the corrosive sublimate in 15½ gallons of water, a solution approximately of the above strength.

This latter formula has been used as a remedy for potato scab. When so used the potatoes are soaked in the solution for one and a half hours, then allowed to dry before planting. The solution is also used for disinfecting knives and pruning implements when removing blighted growth in pear or other trees. A small sponge or cloth swab dipped in the solution and used for wiping of the blades answers the purpose. This is a deadly poison taken internally. Care should be used in using and keeping it. Formalin, not being poisonous, is now preferred in the treatment of potatoes for scab.

FORMALIN SOLUTION.

For Grain Smut:

Formalin	1 pint.
Water	45 gallons.

For Potato Scab:

Formalin	1 pint.
Water	30 gallons.

In treating grains the object is to get each grain moist with the disinfectant. For this purpose the grain may be spread out on a tight floor. The solution may then be sprinkled on the grain from a watering pot, or in some similar way. It is shoveled over and the process continued till each grain is moistened. It is then thrown into a pile, covered, and left for a few hours before sowing. Spread out grain and dry and it is then ready for sowing.

In the treatment for potato scab the tubers are soaked in the liquid for two hours. They may then be spread out, dried and planted. In both instances the treated grain or tubers should not be placed on infected floors or in infected sacks, as there would of course, be danger of reinfection. Likewise treated potatoes should not be planted in soil infected with scab.

SULPHUR.

Sulphur possesses valuable fungicidal properties. It may be purchased in several different forms. What is known as flowers of sulphur is the form usually preferred. It may be dusted over plants without dilution and is a good remedy for the mildews, such as that of the rose, and the powdery mildew of the grape. Florists use the remedy freely in this manner. Again the flowers of sulphur are made into a paste or paint with linseed oil, and applied in the evening to the steam or hot water pipes and the house left closed. The fumes thus generated are found to be an effective remedy for mildew. The fumes from burning stick sulphur or brimstone is fatal to plants, fresh fruit or vegetables, but constitutes a good disinfectant for empty buildings. These when fumigated should be kept closed for some hours.

INSECTICIDES.

STOMACH POISONS.

(For Chewing Insects.)

PARIS GREEN.

Paris green is used either in Bordeaux, in water, or mixed with lime in the form of dust. It may be mixed with Bordeaux mixture in the same proportion as when used with water. In Bordeaux the lime prevents the caustic action of any free arsenious acid. It is therefore advisable to add lime when using Paris green in water, at the rate of 2 lbs. of lime for each pound of Paris green. On apples and similar fruits Paris green is used at the rate of one pound to 200 gallons of liquid; on stone fruits one pound to 300 to 350 gallons is less liable to cause injury. On potatoes, one pound to 100 gallons of liquid may be used. For dusting the potato, cabbage or cotton, the poison may be mixed with slaked lime at the rate of two tablespoonfuls to a quart. Flour may be used in place of lime. A light dusting with this is sufficient. Paris green is insoluble in water and Bordeaux, hence the spray liquid containing it must be kept well agitated to prevent the poison settling at the bottom. Paris green has been frequently adulterated. A small amount of it placed upon a clean glass and allowed to slide gently off should leave no streak of white crystals if pure. If a small amount be dissolved in strong ammonia any undissolved sediment at the bottom is impurity. If in doubt after making these tests forward a sample ounce to the Experiment Station.

LONDON PURPLE.

This arsenite has proved satisfactory with some orchardists who use it. But it is not as safe as Paris green. Its variability of composition is against it. It is used similarly to Paris green, but it is advisable to reduce the quantity somewhat.

ARSENATE OF LEAD.

This substance possesses several advantages over the other common arsenites. It may be used in large quantities without danger of burning foliage. It remains well in suspension in spray liquids, and it adheres well to foliage. It should be purchased in the form of a white-lead-like paste. Disparene is a brand sold by the Bowker Insecticide Co., of Boston, Mass., and Cincinnati, Ohio. Swifts Arsenate of Lead is sold by Swift Bros., Boston, Mass.

To make:

Acetate of Lead	11 oz.
Arsenite of Soda	4 oz.
Water	16 gallons.

Dissolve the ingredients separately, each in two quarts of warm water. Pour together and add water to make 16 gallons.

ARSENITE OF SODA.

White arsenic is cheaper than Paris green and may be used to make arsenite of soda. Some growers here follow this plan and report this cheaper arsenite as entirely satisfactory in orchard spraying. Arsenite of soda is prepared as follows:

Sal. Soda Crystals	4 lbs.
White Arsenic	1 lb.
Water	1 gallon.

Dissolve the soda in one gallon of water, then add the arsenic. Boil until dissolved (about 20 minutes). Replace the water boiled away. This solution is used at the rate of 1 pint to 50 gallons of Bordeaux mixture. If used in water 2 pounds of freshly slaked lime should be added for the above quantities of liquid.

Arsenite of lime may be prepared as follows for use with water in spraying:

Sal Soda Crystals	1 lb.
White Arsenic	1 lb.
Lime	2 lbs.
Water	1 gallon.

Dissolve the Sal. Soda in the water, add the white arsenic, and boil until dissolved. Then add two pounds of freshly slaked lime and boil for twenty minutes. Add water to make two gallons. Use one quart of this stock solution to fifty gallons of water. If to be kept, place in a tight vessel and label "poison."

HELLEBORE.

This poison may be used when the arsenites are deemed objectionable.

Fresh white Hellebore	1 oz.
Water	3 gallons.

CONTACT REMEDIES.

KEROSENE EMULSION.

Kerosene	2 gallons.
Hard soap, Ivory or Whale Oil	1/2 pound.
Water	1 gallon.

Dissolve the soap in the water by boiling. Remove from the fire and add the kerosene. Churn vigorously for ten minutes, or until a cream-like emulsion is formed. A bucket pump to draw up and force the liquid back into the vessel accomplishes the emulsification most easily. When well made no free oil should be seen when a drop is examined on a piece of clean glass; nor should the oil separate upon standing for awhile. The emulsion should always be made fresh as needed. For hard scale use full strength or one part in four of water on dormant plants. For soft scale, one part in eight of water. Rinse growing plants afterwards. For most other insects, plant lice, etc., one part of the emulsion to 15 to 20 of water will answer. This strength may be applied to growing plants with safety. Useful for sucking and soft bodied insects generally, currant worms, rose slugs and cabbage worms.

Kerosene and water is now much used in field operations in lieu of the emulsion and in about the same strength. A special pump for thoroughly mixing the oil and water is necessary. An attachment to the pump permits of regulating the proportion of kerosene to any desired per cent, but the spray liquid should be collected from time to time and allowed to stand for a while in a tall vessel. This will show whether the oil and water are being discharged in the proportions wanted. Sometimes the adjustment on the pump fails to work properly. As strong as ten per cent oil may be used on plants in leaf. For winter treatment 40 per cent kerosene spray has been found desirable for combatting San Jose scale. We have also used the pure kerosene on dormant apple trees in *clear bright weather* with good results.[1] It was applied in the form of a steam-like spray, and only sufficiently to moisten the bark without dripping. A nozzle with a fine orifice is required for this. Kerosene emulsion may be used more freely. Crude petroleum is used in a similar manner and for the same purpose, but requires a careful workman and is more likely to do harm and less desirable than the lime and sulphur spray for San Jose scale.

WHALE OIL SOAP.

In two to five gallons of hot water dissolve one pound of whale oil soap. Useful against mealy bugs and other insects on green home plants. Plants should be rinsed off after treatment. On dormant trees two pounds of the soap to one gallon of water has been used against San Jose scale, but the lime and sulphur wash is now preferred.

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[1] Peach trees were injured by several oil sprays.

PYRETHRUM; BUHACH.

Very effective when fresh, but sometimes difficult to obtain so. It deteriorates on exposure to air, and should always be kept in tight glass or tin vessels. As a powder apply one part to three parts of flour, dusted over the plants. Mix twenty-four hours in advance and keep closed tight till wanted. As a spray mix four ounces of the powder with a gill of alcohol, and add to twelve gallons of water. May be used on maturing fruits. For both chewing and sucking insects. Harmless to man.

TREE TANGLEFOOT.[1]

This sticky material applied in a band about the trunks of apple trees in early spring is a good means of preventing the female canker worm from crawling up the stem. The band should be about six inches wide. It crusts over in about a year. Borer tanglefoot is a preparation for applying about the base of the stems. It has been used here in a small way experimentally without injury to the trees and seems promising as a useful material in some cases against borers, field mice, and even rabbits. It has been applied freely to the stems of young apple and peach trees without injury. In applying remove the earth from about the collar, allow stem to dry then brush clean and apply. Gas tar so used killed peach trees.

TOBACCO.

Various preparations of tobacco are on the market under the names of Rose Leaf Extract of Tobacco, Nikoteen, etc. They, as well as home-made decoctions, and the tobacco dust, are of special value in holding in check the various kinds of plant lice, whether on the roots or areal parts of plants. Tobacco may be used in the form of a dust, or as a decoction with perfect safety. The soil may be watered with a rather strong solution in the case of root lice. The dust may be had from dealers in ton lots for use on young apple trees infested by woolly aphis. From 1/2 pound to six pounds distributed in a shallow trench about the tree according to size, and covered with soil has given excellent satisfaction. Not necessary to treat old trees. For three or four-year old trees a tablespoonful of the Rose

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[1] Manufactured by the O. and W. Thum Co., Grand Rapids, Mich.

Leaf Extract in a half pint of water similarly used, gives good results. A home-made decoction may be provided by boiling a quantity of the stems in water sufficiently long to obtain a strong tea or coffee-like liquid.

LIME AND SULPHUR WASH.

Stone Lime	20 pounds.
Flowers of Sulphur	15 pounds.
Water	50 gallons.

To prepare: Place over a fire a 25-gallon iron kettle, containing four or five gallons of water. When the water is warm place the lime in the kettle; when slaking begins add the sulphur which has previously been worked into a paste with water. Stir, and add more hot water as needed to bring the mass to a thick well-mixed paste. Add water to make 12 or 15 gallons, and boil with, stirring from time to time for forty minutes or longer. Then add water to make 50 gallons. Strain the wash through a fine strainer and apply hot. On a large scale the wash may be more conveniently made in barrels and cooked by means of steam.

Formulas frequently include in the quantities above given 15 pounds of salt. But it is now commonly deemed unnecessary. The lime and sulphur wash requires thorough cooking as essential to its effectiveness against San Jose scale. This wash is injurious to clothing and irritating to the eyes. It is desirable therefore to wear old clothes when engaged in spraying with it. It is also desirable to clean the spray pump daily, as otherwise the wash will corrode the metals.

LIME, SULPHUR AND LYE WASH.

The following is a formula which may be prepared without cooking. This class of washes has been considered by some as less reliable than the regular cooked lime and sulphur wash. It has been used at this station, and thus far has proved entirely satisfactory. Further trials however, may alter our present view. It requires only fifteen to twenty minutes in making, and may be prepared in a barrel, as follows:

Fresh lump lime	20 pounds.
Flowers of sulphur	10 pounds.
Lye, Babbitts, or Merrywar	5 pounds.
Water	50 gallons.

Place the lime in the barrel, dry. Make a paste of the sulphur, pour this over the lime and add 10 to 12 gallons of boiling water. When boiling ceases, put in half the lye. Cover the barrel with a sack, and when the wash tends to boil over pour in a little cold water. When boiling ceases add the remainder of the lye and cover as before. Watch to prevent boiling over. Add water to make fifty gallons, and apply hot. There is no clogging of the nozzles however, even if the wash becomes cold.

These washes must not be used except on dormant trees. Where San Jose scale infection is very bad, two sprayings—one in the fall and another in the early spring (before the buds swell) will be desirable. Afterwards a spraying every second year will keep down the scale to harmless numbers.

GASEOUS POISONS.

CARBON BISULPHIDE.

This is a highly volatile liquid, the vapors of which are heavier than air. Very penetrating and deadly to the small forms of animal life. The strong fumes are dangerous to man. It is used against rodents, insects affecting underground parts of plants, such as woolly aphis, ants, and for destroying insects in stored grain, fruits and vegetables. In the case of root insects a small quantity may be poured into a hole made in the soil near the plant. This opening should then be closed with a ball of moist earth. A wet sack spread on the spot helps. The liquid should not come in contact with the roots or stems of the plant. Poured in on the stems around the collar it proves fatal even to sassafras sprouts. (See Bulletin 91 of this Station). But the fumes if not too long continued or excessively strong, are not injurious to the roots. The treatment for cuts is similar. The fumes are deadly to borers affecting the collar or base of the stem of young peach trees, and the writer has used it repeatedly for the peach borer with the greatest satisfaction. With a spade or hoe a shallow funnel-shaped cavity is made in the soil about the base of the stem, a teaspoonful of the liquid is then poured upon the soil in the cavity in two or three spots, or a circle six inches from the stem. The loose soil is then quickly heaped up around the stem and patted down with the back of the spade. In twenty to thirty minutes the borers will be dead. As many as nine dead borers have been taken from a single stem in this length of time after treatment. No scraping of the trunk or other preparation is necessary. In very loose soil or for larger trees, double the amount of liquid should be used. This work should be done in early spring or fall. When the tree is free from borers then further infestation should be guarded against by wrapping the base of the trunks with resined or oiled paper, tobacco leaves, etc., extending below the surface of the soil and some inches above, tying the paper around the stem lightly at the top. Borer tanglefoot, sticky grafting wax, to which is added a little castor oil and applied warm (castor oil and rosin melted together make a sticky compound), and white lead paint mixed with pure linseed oil, but containing no turpentine, have also been used. Such measures have to be repeated from year to year and should be examined from time to time. Stored grain, seeds and other products, fruits and vegetables, may be freed from insect pests by the use of this material: One pound of carbon bisulphide is sufficient for a thousand cubic feet, provided the bins or containers are tight. When a chamber is used for the fumigation, care must be taken to have it tight around the sides and floors. The liquid should be placed in the upper part of the compartment. The fumigation should not be continued as a rule, for more than 24 hours, after which an hour's free ventilation should be given. This is sufficient for all odor to disappear. The operator should remember constantly that the fumes are very inflammable and explosive. Hence no lamp or fire should be about while using this fumigant. It costs in small amounts 20 cents a pint—larger quantities may be had at 10 to 12 cents a pint.

HYDROCYANIC ACID GAS.

This fumigant is a dangerous and rapid poison and its use should be undertaken only by a competent person or under his directions. It has come into extensive use in recent years for the fumigation of nursery stock, grown where liable to infestation by San Jose scale. A fumigation house for treatment of stock by means of this gas is now a part of the equipment of many nurseries. Some state laws require such fumigation. Necessary directions may be had upon application to the Experiment Station.

HINTS FOR COMBATTING COMMON INSECTS AND PLANT DISEASES.

APPLE.

Insects:

Aphis—Louse. Lives on young shoots and leaves, sucking the juice. Spray with kerosene emulsion or tobacco decoction when leaves appear. Eggs killed by lime and sulphur spray or pure kerosene spray of dormant trees. (Idaho Expt. Station, Bul. 40, Jan. 1904.)

Apple-maggot—Railroad-worm. Tunnels about in the flesh. Keep windfalls picked up and fed to hogs or destroyed.

Bark-beetle—Pin-hole borer. Small black beetle, bores holes and tunnels in the bark. Prefers weak trees. Stimulate trees by pruning, manure and cultivation. Cut out and burn infected trees. Pile trimmings about the orchard in late fall for traps and burn in midwinter. Attend to wild plum, peach other infected plants near orchard.

Bud-moth. Small caterpillars feeding upon the leaves of the unfolding buds. Spray with Paris green or Arsenate of Lead as soon as buds show green leaf tips. Repeat before blossoms open. Repeat after blossoms fall.

Bud-borer. Prune off terminals of young trees and water-sprouts from older trees and burn.

Codling-moth—Apple-worm. Larva tunnels inside the apple around the core. Spray with Arsenate of Lead or Paris green immediately after blossoms fall. It is well to combine the arsenical with Bordeaux mixture. A spraying July 15, to Aug. 15, is frequently needed to prevent damage by the second or late brood.

Curculio—same as Plum and Peach-curculio. "Stings" the apple, making them more or less knotty. Grub burrows inside the fruit. Woodland adjoining orchards objectionable. Spray with Arsenate of Lead in Bordeaux mixture just as trees are coming into bloom and repeat at intervals of ten days, giving four sprayings.

Canker-worm—Measuring-worm. Feeds upon the leaves. Spray as for codling-moth. Bands of Tree-tanglefoot in bands six inches wide around trunks before buds swell.

Narrow-winged katydid. Spray as for late brood codling-moth.

Tent-caterpillar. Weave tent-like webs on branches, devouring the foliage. Spray as for codling-moth. Egg masses encircling base of twigs. Collect and destroy in winter.

San Jose scale. Small round. ash-colored scales, with slight protuberance in center, insect beneath. When numerous, give bark a scurvy appearance. Suck sap. Spray trees in fall or early spring while dormant, with lime and sulphur wash, which see—also kerosene preparations. Destroy badly infested and weakened trees. (See Ark. Bulletin, No. 92.)

Oyster-shell bark-louse. Elongated club-shaped scales. Giving twigs a peculiar roughened appearance. Scales filled with minute eggs in winter. Spray with kerosene emulsion or whale-oil soap when eggs hatch in spring.

Flat-headed borer. Grubs burrow in trunks and branches. Weak trees more liable to attack. Stimulate trees by manure, pruning and cultivation.

Round-headed borer. Cylindrical grub. Burrows mostly at base of stem or collar. In May and twice later at intervals of three weeks apply a strong solution of soft soap to which has been added a little crude carbolic acid, or paint base of trees with borer tanglefoot or pure white lead and linseed oil. Object: to prevent egg-laying. Examine trees in early fall for young grubs. Dig out.

FUNGI:

Bitter-rot. Appears on fruit commonly during moist "muggy" weather from July on, as minute black dots, becoming black depressed areas. May develop very rapidly. Forms black cankers on branches. Search for cankered limbs in winter. Cut out and burn. Destroy affected falling fruit. Allow no mummy apples to hang over winter. Trim up and thin tops of trees in low or damp spots of orchard. Spray with Bordeaux July 10 to 15, and twice or three times later, at intervals of 12 to 15 days if the weather conditions favor the disease. Further spraying if necessary, using ammonical copper carbonate solution. Fair skinned apples may be injured. Increase lime, or use weaker Bordeaux.

Powdery-mildew. Affects leaves and shoots of apple, cherry, quince, peach and other trees. Appears about mid-summer. More troublesome on nursery stock and cherry trees here. Spray when leaves are about half grown, with ammonia copper carbonate, Bordeaux, or sulphide of potassium, and repeat at intervals of 12 days as seems necessary.

Rust. Causes yellow spots on the leaves, often doing great damage to foliage. Affects fruit to some extent and occasionally twigs. Spreads to apples from red cedar, on which it forms cedar apples. Where it affects apples, destroy cedar trees. Spraying seems to be of little or no value.

Scab. Affects fruit, foliage and occasionally on green twigs. On foliage appears as smoky green areas in the leaf tissue, seen by holding leaf toward the light. On fruit forms scabby spots and later cracks. (1) Spray before buds swell, with copper sulphate solution; (2) spray with Bordeaux as buds unfold; (3) spray with Bordeaux after blossoms fall; (4) follow with a spraying seven to ten days later, if weather is cool and wet. Some omit the first spraying for scab, but where the disease has been severe it should be given.

Star-fungus (Phyllosticta. Sp.) Spray as for scab.

Sooty-blotch. Dark sooty blotches on fruit. Give general treatment below.

Twig-blight. Affects twigs, leaves and blossoms, turning them black same as pear blight. A bacterial disease. Not likely to appear on trees receiving the general spray treatment for other diseases as given below, even when it has existed the preceding season.

GENERAL SPRAYING OF ORCHARD.

Ordinarily three to five sprayings yearly applied at the proper time will largely protect apple-orchards against the more common fungus diseases and insect pests. Later brood of codling-moth, bitter rot, scale insects, borers, and aphis, however, require special attention.

1. Spray with arsenate of lead or Paris green in Bordeaux as buds show green tips of leaves. For bud moth and scab.
2. Spray second time immediately after blossoms fall for codling-moth, curculio, canker, tent caterpillar and scab. Same as No. 1.
3. Spray third time in seven to ten days. Bordeaux mixture.
4. July 10 to 15, if conditions favor bitter rot, or disease appears —Bordeaux mixture containing Arsenate of Lead.
5. July 25 to 30. Bordeaux mixture. For bitter rot, and continued at intervals of 12 to 15 days if necessary, using weaker Bordeaux mixture on fair skinned apples, which are liable to injury.

ASPARAGUS:

Insects—Beetles. Spray with Arsenate of Lead or Hellebore, after cutting season. Keep the shoots well cut in early spring.

Fungi—Rust. Cut stalks of beds and escaped plants with hoe close to ground in fall and burn tops on the ground. Select fresh moist land, fertilize and cultivate well. Spray with Resin Bordeaux two or three times after cutting crop, at intervals of ten days.

BEAN:

Insects—Weevil. Submit seeds to fumes of carbon bisulphide for 24 hours in air-tight vessel.

Fungi—Pod-rust, Anthracnose. Roundish spots on pods and leaves often tinged with purple at edges. Spray with Bordeaux when first true leaf has expanded. Repeat at intervals to keep the foliage covered. Where severe rotate and destroy old vines.

BLACKBERRY:

Fungi—Crown-gall—see raspberry.

Rust—Orange-rust. Young affected shoots appear yellowish and sickly. Later the leaves show bright orange masses of dust on the under side. The fungus is perennial in the underground parts of the plant. Some varieties are much more susceptible to rust than others. The only treatment is to promptly dig up and burn infected plants.

CABBAGE AND CAULIFLOWER:

Fungi—Cabbage-rot. A bacterial disease for which no remedy is known. Affects heads in field or storage. Liable to become worse from year to year where it occurs. Thrives under cool, damp conditions. Avoid infected lands. Destroy diseased cabbages. If liable to occur soak seed 15 minutes in corrosive sublimate solution or formalin.

Insects—Aphis or Louse. Grayish lice on under sides of leaves, sucking insects. Spray with kerosene emulsion or whale oil soap solution upon first appearance. Destroy remnants of crop in fall.

Cabbage-worms. Devour the foliage. Dust young plants with Paris green and lime. Two tablespoonfuls to a quart of slaked lime. Use pyrethrum or Hellebore on headed plants if necessary.

Flea-beetle. Minute jumping beetles, feeding on leaves. Dust with strong tobacco, wood ashes or dust Bordeaux.

Harlequin-bug. Flat-backed black bug with red or yellow markings. Sucks the juices. Trap in infested grounds under blocks or piles of rubbish in fall or early winter. Plant mustard in advance on ground to be occupied by late cabbage, sowing it in rows a foot apart. When the leaves are covered with eggs of the insect mow and burn.

CELERY:

Insects—Caterpillar—"Parsley-worm." Feeds upon the leaves. Arsenite, early, lightly applied. Later, hand picking.

Green lettuce-worms. See under Lettuce.

Maggot. Appears when plants are being earthed up. Burrows in the stalks. Dust with slaked lime before earthing up. Entirely effective.

Fungi—Leaf-spot—"Leaf-blight." Diseases causing rusty spots on leaves and stalks. Spray with Bordeaux soon after transplanting. A dust spray with flowers of sulphur is good. Repeat at short intervals as necessary, during growth.

CHERRY:

Insects—Aphis, or Louse. See under Peach.

Canker-worm. See under Apple.

Curculio. See under Plum.

Slug. Eats the soft tissues of the leaves. Spray with Hellebore, arsenite, or dust spray. Repeat in ten to twelve days if necessary.

Fungi—Black-knot. See under Plum.

Brown-rot. Affects flowers, leaves and fruit. Spray with Bordeaux mixture as buds start. Repeat as soon as fruit sets. Afterwards with ammonia copper carbonate solution at intervals of 6 to 14 days till fruit begins to color.

CORN:

Insects—Grain-beetle or weevil, and the larva of the grain moth often damages sound grain. Remedy: Bisulphide of carbon.

Fungi—Smut. Attacks ears and stalks. Familiar. Remedy: Use seed from clean fields; avoid the use of fresh stable manures on corn land. Cut out early and burn smutted stalks. Seed treatment as in oat smut is ineffectual.

GOOSEBERRY:

Insects—Currant-worm. Devours the leaves. Apply hellebore spray or dust. Arsenate of lead may be used for first two sprayings as soon as leaves appear.

Fruit-worm. Lives in the berry. Destroy infected berries.

Fungi—Mildew. A dirty white growth on the fruit, leaves and shoots. English sorts suffer most. Spray with Bordeaux as buds break, and when leaves have expanded repeat at intervals of ten days. As fruit matures, substitute potassium sulphide.

GRAIN. (Stored.) See Corn.

GRAPE:

Insects—Epimenis—Annular-banded, dark colored worms feeding upon the terminal shoots of the grape and upon the leaves. Spray with Paris green upon appearance, or later in the season with Hellebore.

Berry-moth. Larva about one-fourth inch long. Enters berry, making a small purplish hole. Pick or gather up injured berries or make into vinegar. On touching berry larva wiggles out and escapes unless care is used to prevent it. Use diluted kerosene emulsion.

Curculio. Small black larva, makes a little black hole in skin with surrounding discoloration. Collect and destroy infested berries from time to time in May and June. The beetle may be jarred down on sheets as in the case of the plum or peach curculio. Collect and destroy.

Flea-beetle. Small metallic blue insect, feed upon the foliage both as larva and adults. Spray with Arsenate of Lead or Paris green when beetles attack buds, and when the larva appears.

Leaf-hopper. Infects the underside of leaves, sucking the sap. Spray (for young) the underside of the foliage with strong tobacco decoction (Rose Leaf Extract) or kerosene emulsion. Rake up the fallen leaves in the fall in piles or rows to trap the hibernating adults. Then in October or November spray rubbish with kerosene (if necessary) and burn. Smear stakes in spring with sticky "tree-tanglefoot." Use sticky paper in connection with jarring the vines. Torches or fires in the evening attract many of the insects.

Leaf-folder. Larvæ fold leaves and feed upon them. Appear about mid-summer. Spray in advance with Arsenate of Lead. Burn dead leaves and rubbish in fall.

Tree-cricket. Small delicate insect, deposits eggs in the canes in pin-hole punctures at intervals. Remedy: Burn injured trimmings.

Root-borer. Large white knotty grub (one to a vine) working in roots, usually kills vine before damage is known. First indication, sudden wilting of vine. Remedy: cut back vine to one or two shoots. Hunt out borer or use carbon bisulphide. Allow no decaying oak stumps about vineyards.

Fungi—Anthracnose, Scab, or Bird-eye rot. Attacks fruit, leaves, stem. Spray dormant vines with copper sulphate solution thoroughly, post, labels, wires and stems. Use Bordeaux mixture when first leaves are half grown.

Black-rot. Attacks berries when nearly grown, causing them to turn black and shrivel. Spray with copper sulphate solution before buds swell. Bordeaux mixture, as soon as fruit sets. Repeating the application at intervals of eight to ten days through June. Spray with ammonia copper carbonate solution as fruit approaches maturity.

Downy mildew. Appears in frost-like patches on under surface of the leaves, causing them to turn yellowish and fall prematurely. Affects fruit also, causing gray and brown rot. Caused much injury in Arkansas in 1905. Remedy same as black rot.

Powdery-mildew. Less serious commonly than Downy-mildew. Appears upon the upper surface of the leaves, on shoots, and on the berries early in the season and through the summer, forming whitish patches. (Brown beneath.) Spray with ammonia copper sulphate solution before fruit is gathered or Bordeaux, and with the latter after fruit is gathered. Dust spray, sulphur or Maxwell formula, when dew is on.

MELONS—CUCUMBERS:

Insects—Aphis, Louse. Affects underside of leaves, sucks sap, causing dwarfed, contorted appearance of leaves. Watch for first signs and destroy badly infested plants. Spray with strong decoction of tobacco (Rose Leaf Extract) or kerosene emulsion, upon first appearance.

Melon-worm. Tunnels beneath the surface of the melons and related fruits. Remedies: Gather and destroy infested fruits. Use Hellebore, arsenate of lead early in season. Bury or burn rubbish, leaves, weeds, grass, etc., about the field after crop is harvested.

Pickle-worm. Larva bores holes in fruit, especially cucumbers. Remedy: Gathering and destroying infested fruits—grow early melons. Plant early squash in succession as traps. The larvae collect in the flowers. Gather daily. See Arkansas bulletin 69.

Striped-beetle—Twelve-spotted beetle. Attack the young seedlings. Remedy: Sow more seed than needed, afterwards thin the plants. Keep plants covered with Bordeaux mixture. Dust hills with tobacco or plaster (containing a pint of kerosene, ''Kreso-dip'' or carbolic acid to the bushel) beginning as soon as the seeds sprout.

Fungi—Anthracnose. Affects cucumbers, melons and watermelons. Appears as rather large circular spots on the leaves. Attacks stems also. Fruits of water-melons are affected as well as the other parts. Spray with Bordeaux mixture on appearance. Destroy old vines each year. Repeat at intervals of two weeks.

Leaf-blight. Affects musk-melons. Begins as small brown spots, showing usually concentric rings. Favored by warm humid weather. Spray thoroughly as soon as vines commence to run, with Bordeaux mixture at intervals of 7 to 14 days throughout the season. Later sprayings should be more frequent.

Downy-mildew. Attacks various cucurbits, causes leaves to turn yellowish, affecting the old leaves first, more or less distinct angular yellowish spots appear, showing under favorable conditions, violet colored spores beneath. Spreads with great rapidity. Favored by warm, moist conditions. Spray with Bordeaux soon after vines commence to run at intervals of 7 to 9 days or often enough to keep vines covered with the fungicide.

Wilt. One form of this disease is due to bacteria. It is characterized by a sudden wilting of the vine. It appears about the time the vine begins to run. The infection is held to be carried by the cucumber beetles and squash bugs from diseased to healthy plants. Remedy: Gather and burn infected vines. One form of wilt disease is due to a species of fungus. Spraying of doubtful value. Rotation desirable in the latter type of the disease.

NURSERY STOCK:

Insects—Aphids or plant-lice. Spray with strong tobacco decoction or kerosene emulsion when insects appear or as leaves start. Repeat as necessary.

Woolly-aphis. Whitish, mold-like tufts about wounds and on water-sprouts on apple. Apply kerosene emulsion. Causes warty roots. Most injurious to young trees. Reject badly infested nursery trees. Dip roots of slightly infected trees in kerosene emulsion, one part to

20 parts of water. Tobacco dust buried a few inches deep in a trench about infected trees is satisfactory. Use one-half to three pounds to the tree on young orchard trees.

FUNGI:

The foliage of young trees is subject to various blights, mildews, etc., or fungus diseases. Remedy: when attack is anticipated, spray with Bordeaux mixture as soon as leaves appear, and at intervals of 12 to 14 days. (See apple-mildew.) Promote health of the trees—by using for nursery only well-drained ground, by cultivation and the use of fertilizers.

Crown-gall. Appears in one or more large rough knots on the stem of apple trees or upon both stem and roots of the trees. Most liable to occur at the union of grafted trees. Not fatal, but affecting the vigor of old trees. Buyers should reject diseased trees or plants. The use of long scions and short roots for grafts it is thought, renders them less liable to attack by placing the union some inches below the surface of the soil. Waxed unions are also an advantage. Avoid seedlings from infected land. Grow other crops on infected land.

Hairy-root. Characterized by the production of bunches of numerous small roots. Remedy: cull out affected seedlings, or nursery trees.

OATS:

Fungi—Smut. Affected grains become masses of black, dust-like spores. Remedy:Sprinkle seed oats with formalin. See formalin treatment.

ONION:

Fungi—Smut. Appearing as dark spots on the first leaves of seedlings. Remedy: Plant other crops in infested soil. Use sets or transplanted seedlings. Formalin, one pound to 30 gallons of water, sprinkled on the drilled seed before covering them, has been recommended as an effective remedy. Again, in the drills 100 lbs. per acre of a mixture of sulphur, two parts by weight to one of slaked lime.

PEA:

Insects—Green pea-louse. Sucks the sap of stems and leaves. Multiply rapidly. Brush the vines in mid-day, following with the cultivator. Dust spray, Maxwell formula, omitting the arsenite, or liquid whale-oil soap, or kerosene emulsion.

Fungi—Mildew. Overspreads the foliage. Spray with Bordeaux mixture when mildew appears. Repeat in two weeks or substitute potassium sulphide solution.

PEACH:

Insects—Aphis. Small black sucking lice, living upon the leaves and roots. The root form thrives in sandy lands. Spray foliage with kerosene emulsion or strong tobacco decoction. For the root form apply powdered tobacco. (See apple—Woolly-aphis.)

Borer. Tunnels under the bark at the base of the trunk, and the upper roots. Remedy: Carbon bisulphide, as directed. Dig out borers with knife or hook in early spring and late fall, and apply borer tangle-foot.

Fruit-tree bark-beetle—Pin-hole borer. A small black beetle. Bores small holes in the bark. Numerous larvæ tunnel beneath the bark. Attacks various fruit trees. Remedy: Destroy badly infested trees. Stimulate vigor of trees by tillage, pruning, fertilizers. Use trimmings in the fall as a trap. Then burn the grub-infested trimmings in winter.

Curculio. Grub infests the growing fruit. Adult is a small grayish snout-beetle. Spray with Arsenate of Lead before trees blossom. Repeat when fruit has set. Repeat a week later. Keep hogs in the orchard to eat the fallen fruit, or gather and feed it. The use of the ''Curculio Catcher'' as employed by plum growers is effective. It is used with greatest success in the cooler part of the morning, and on cool, cloudy days. Begin the use of this implement immediately after flowering or after the third spraying, and jar the trees at least every second or third morning, continuing the use of the ''catcher'' as long as one or two weevils are found to the tree. Feed culls promptly or bury in a pit, the bottom of which has been thickly covered with slaked lime.

San Jose scale. See apple.

Fungi—Black spot. Appears as sooty spots on the surface of the peach, shriveling and cracking result at last if the attack is severe. Late varieties most liable to suffer. Spray as for Leaf Curl. Give one or two applications of potassium sulphide solution when the fruit is about half grown. Improve the vigor of the trees.

Brown rot—twig blight. Affects twigs, flowers and fruit. Serious and rapid. Occurs also on plums and cherries, and to some extent on apples and pears. Causes a blighting of the flowers and twigs. Fruit attacked quickly rots. It often appears about ripening time. Some varieties are very susceptible. Bees and wasps seem to be instrumental in carrying the spores. Excess of nitrogen and rankness of growth favor the destructiveness of the disease. Diseased tissues are soon covered with a growth of dusty greyish spores. Warm, humid weather favors the spread and destructiveness of the disease. Pick off, clean up and burn all mummied fruits. Prune out diseased twigs. Spray trees in winter with the Standard Bordeaux mixture, or copper sulphate solution. Repeat, using weaker Bordeaux when fruit has set (including Arsenate of Lead for the curculio). Repeat one or more times at intervals of two weeks with weaker Bordeaux if conditions favor the disease. As fruit approaches ripening watch carefully for rot and pick off and burn infested fruits. Spray at this stage if season is wet, with ammonical solution of copper carbonate.

Leaf-curl. Causes a crinkled discolored appearance of the leaves. Cold nights or sudden checks during active growth in the spring favor this disease. Spray dormant trees with standard Bordeaux mixture, or with the lime and sulphur spray, especially if San Jose scale is present.

Powdery-mildew. See apple.

Rosette—Causes clustered growth bearing numerous rolled yellowish leaves, which incline to fall prematurely. Fatal. May be spread in budding. Grub out and burn diseased trees as soon as discovered. Not at present known here.

Shot-hole fungus, "Leaf-spot." Appears on leaves as small purplish spots. The spots soon turn brown and die. The dead tissue falling out leaves a clear cut hole. The leaves are inclined to turn yellow and fall prematurely. Very injurious. It may prevent the proper maturing of the fruit and rapidly weakens the trees. The disease is easily controlled, however. Spray with weaker Bordeaux mixture as soon as blossoms are shed, and repeat twice or three times at intervals of two weeks.

For Japanese plums and cherries use same, substituting in the later sprayings, or as fruit matures, the ammonical solution of copper sulphate.

[1]*Yellows.* Has not as yet been found here. Same remedy as Rosette. The pronounced symptoms are premature ripening of the fruit on part or all of the tree. The prematurely ripened peaches are more or less red or purple spotted on the skin, and streaked or

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[1] Bulletin 9, by Dr. E. F. Smith, Botanical Division U. S. Department of Agriculture, 1888; also Report of Sec. of Agriculture for 1888, pp. 393-398.

splashed within. The same season, or next there will appear dwarfed tufted growths of twigs bearing small pale-green leaves, or these may be yellowish, reddish or white. Affects nectarines, apricots and almonds.

Not found here yet.

PEAR:

Insects—Borer, Bud-moth, Codling moth, San Jose scale. See apple.

Fungi—Blight. Kills twigs and limbs. The leaves suddenly droop and turn black. They remain on the trees after dying. The disease is due to bacteria. It is most disastrous to trees making a luxuriant growth. It is spread chiefly by bees during the blossoming period. Certain varieties are especially susceptible. The grower should cultivate the pear orchard only while young. As soon as the trees reach bearing age seed the orchard down to grass. Avoid highly manured soils for pears. Use potash fertilizer. Seek to secure a moderate firm growth. Destroy blighted pear trees and blighted limbs in fall or winter, cutting limbs a foot below the diseased area. Sterilize the knife blade frequently by wiping it with a cloth moist with carbolic acid or corrosive sublimate solution. Keep fruit spores and water sprouts off the main limbs and trunks. Cut out blighted twigs some weeks after the blossoming season. General spraying as applied to apple orchards is apparently of some value in preventing the spread of the disease.

Leaf-spot. See quince.

PLUM:

Insects—Aphis, or louse. See peach.

Curculio. See peach.

Fruit-tree bark-beetle. See peach.

San Jose scale. See apple.

Fungi—Black-knot. Forms ugly black warty excrescences on the twigs and limbs. Affects cherries also. Cut out and burn affected parts in the fall. Search out and destroy affected wild plums and cherries. On larger limbs and trunks of orchard trees cut out the knot and wash the surface with Bordeaux mixture. Paint wounds with sulphur and linseed oil. Watch for reappearance of knots during summer and destroy. If the disease is troublesome spray trees with Bordeaux mixture as buds start, and after blossoms have fallen.

Plum-pockets, or bladders. Organism related to the fungus which causes leaf curl of the peach, which see.

Powdery-mildew. See nursery stock, and apple.

Rot. See peach.

Shot-hole fungus or leaf-blight. See peach.

POTATO:

Insects—Blister beetle. Elongated beetles, feeding on the foliage. See Colorado Potato Beetle.

Colorado Potato-beetle. Short roundish striped beetles, feeding both as adults and larvæ upon the foliage. Remedy: Liquid or dust spray, with arsenite doubled in amount. When the beetles or young appear repeat if necessary. See Paris green.

Flea-beetle. The adults eat holes in the leaves. Spray with Bordeaux containing an arsenite. Repeat if necessary.

Stalk-weevil. Grub tunnels inside the stalk. Remedy: Burn the infested vines.

Fungi—Early-blight. Appears as spotting of the leaves. As the circular spots slowly increase in size the leaf turns yellow and brown and the edges curl. Spraying not wholly satisfactory, but is recommended. First spraying, Bordeaux, when the plants are a few inches high. Second and third at intervals of two weeks.

Late-blight. Appears late or about mid-summer, or later. Caused a sudden blacking of the leaves or parts of them. The affected leaves present a frosty appearance beneath. Moist weather favors its destructiveness. Remedy: Spray with Bordeaux before disease appears, beginning early in July, cover all parts of the leaves and stems. Two more sprayings should be given at intervals of 7 to 21 days according to weather conditions.

Scab. Affects tubers, causing the well-known scabby spots. Potatoes should not be planted in infected land. Barnyard manure if infected tends to increase scabbiness. Use clean tubers and soak in formalin or corrosive sublimate. See directions. Use care to prevent reinfection of treated tubers.

QUINCE:

Insects—Borer. See apple.

Curculio. Grub infests growing fruit. See apple.

Blight. See pear.

Fungi—Leaf-blight, Fruit-spot. Appears in early summer as small circular brown spots on the leaves. Attacks also the fruit. Often causes premature shedding of the foliage and corky cracking of the fruit. Spray with Bordeaux when blossom buds appear. Repeat soon after blossoms fall. Give from two to three additional sprayings at intervals of two weeks. The same disease also affects the pear.

RASPBERRY:

Insects—Cane-borer. Slender black beetle; girdles the canes near the tip in spring. Grub bores down the cane. Cut and burn the infected canes.

Snowy tree-cricket. Damage consists of punctures in the canes in which the eggs are deposited. These are close together in vertical rows. Cut out the injured canes in early spring or winter and burn.

Fungi—Anthracnose, or Cane-rust. Whitish spots on stems with purplish borders. Cut out and burn badly infected canes. Difficult to control. Spray with copper sulphate solution before buds swell. Bordeaux mixture when growth has started. Repeat second spraying two to three times at intervals of one to three weeks according to weather conditions. Give special attention to covering thoroughly the young shoots. Cut out and burn the old and diseased canes after the crop is gathered.

Crown-gall. Excrescences or galls on the roots and lower parts of the canes. No cure. Dig out and burn affected plants. Avoid infected stock and land when making plantings. Affects apples, peach and other fruit trees.

Orange-rust. See blackberry.

ROSE:

Insects—Aphis. Green plant louse, sucking the juice of the young shoots and foliage. Spray with decoction of tobacco.

Leaf-hopper. Sucks the sap, living on the under side of the leaf. Spray with kerosene emulsion.

Red-spider. Minute red or whitish mites infesting the under side of the leaves. They flourish on the older leaves, and in dry atmospheres. A few forcible sprayings with cold or soapy water directed against the under side of the leaves checks them.

Slug. Feeds upon the foliage. Spray with Hellebore or arsenite in Bordeaux when they appear.

Fungi—Black-spot. Forms irregular black spots upon the leaves. Spray with Bordeaux mixture before buds unfold. Ammonia copper carbonate solution subsequently once a week. Gather and burn diseased and fallen foliage.

Mildew. Powdery white spots with more or less crinkling and falling of the foliage. Affects young shoots also. Dust spray with sulphur. Spray with potassium sulphide solution or the ammonia copper-carbonate solution. See sulphur.

STRAWBERRY:

Insects—Crown-borer. Grub works in crown of the plant in midsummer. The beetle cannot fly. Avoid plants from infested fields, or select plants which started late and dig them in early spring. Burn over after picking and plow old fields under in late June and cultivate in other crops. More likely to trouble old fields.

Grub. The larvæ of the May-beetle live in the soil three seasons, feeding upon the roots. Avoid old sod lands newly turned. They should be thoroughly cultivated for one or two seasons prior to planting in strawberries.

Leaf-roller. Small brownish caterpillar, folds the leaflets along the mid rib and fastens them. Feeds upon the leaves, causing them to look brown and scorched. Mow foliage after gathering the crop and after a day or two burn over the field. There are also other insect pests and diseases which this treatment will reduce. Otherwise dust or liquid spraying with an arsenite in August will be desirable.

Weevil. A small, reddish-brown snout beetle. The beetle deposits an egg in a flower bud then cuts the stem below, and the bud falls to the ground where the eggs hatch and soon becomes an adult. The insect affects only staminate varieties or pistillates whose flowers have stamens. No satisfactory treatment has as yet been found. It is advised however, that growers plant as largely as possible of pistillates with only sufficient staminates for pollination, where the weevil has appeared. Burn over fields in late fall.

Fungi—Leaf-blight—leaf-spot. Appears as purplish spots on the leaves. Develops mainly after the fruit is picked. Lessens the yield the following year. Where serious, mow and burn off foliage after fruiting season.

Mildew. A cob-web-like mildew, most likely to occur in wet situations. It affects fruit and foliage, causing the latter to fold on the mid rib and appear as if suffering for water. Spray with Bordeaux when growth starts in the spring. Repeat when first fruits are setting, and again after fruiting.

DEALERS.

Spraying machinery. Any of the firms mentioned will send illustrated catalogues to interested persons. Several such should be obtained in order to make an intelligent selection:

Beane Chamberlain Co., Los Angeles, Cal.; E. C. Brown Co., Rochester, N. Y.; Cushman Motor Co., Lincoln, Neb.; Deming Co., Salem, Ohio; R. H. Deyo & Co., Binghamton, N. Y.; Dust Sprayer Mfg. Co., Kansas City, Mo.; Friend Mfg. Co., Gasport, N. Y.; Field Force Pump Co., Elvira, N. Y.; Goulds Mfg. Co., Seneca Falls, N. Y.; Haldeman Dust Sprayer Mfg. Co., Springfield, Mo.; Hardie Mfg. Co., Hudson, Mich.; John Deere Plow Co., Kansas City, Mo.; Leggett Bros., 301 Pearl St., New York, N. Y.; F. E. Myers & Bro., Ashland, Ohio; Morrill & Morley, Benton Harbor, Mich.; Niagara Gas Sprayer Co., Middleport, N. Y.; Olds Gas Power Co., Lansing, Mich.; Rochester Spray Pump Co., Rochester, N. Y.; Spray Motor Co., Buffalo, N. Y.; Wallace Machine Co., Champaign, Ill.

Spraying chemicals:

In case satisfactory prices cannot be obtained of local dealers in spraying materials growers of a neighborhood would do well to club together in order to buy in wholesale lots and write to some of the following houses:

Adler Color & Chemical Works, New York, N. Y.
American Horticultural Distributing Co., Martinsburg, W. Va.
Ausbacher & Co., New York City, Chicago, Ill.
James A. Blanchard & Co., New York, N. Y.
Bowker Insecticide Co., Boston, Mass.
Hammond's Slug Shot Works, Fishkill-on-Hudson, N. Y.
L. Lawhorn & Co., Memphis, Tenn.
Leggett & Bros., 301 Pearl St., New York.
Merrimac Chemical Co., Boston, Mass.
Missouri Valley Seed Co., St. Joseph, Mo.
Monmouth Chemical Works, Shrewsbury, N. J.
Myers Fert. and Junk Co., St. Louis, Mo.
Nichols Copper Co., New York, N. Y.
J. Pfeiffer, New York, N. Y.
W. S. Powell & Co., Baltimore, Md.
B. G. Pratt & Co., New York, N. Y.
Tobacco Warehouse & Trading Co., Louisville, Ky.

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Agricultural Experiment Station

FAYETTEVILLE, ARKANSAS

* * *

TWENTY-FIRST ANNUAL REPORT

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1908

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AGRICULTURAL
EXPERIMENT STATION

FAYETTEVILLE, ARKANSAS

TWENTY-FIRST ANNUAL REPORT

1908

Agricultural Experiment Station.

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Committee on Agricultural Department, President of the University, Director of the Station.

STATION STAFF.

C. F. Adams	Acting Director and Entomologist
R. R. Dinwiddie	Pathologist and Bacteriologist
Ernest Walker	Horticulturist
V. A. Hooper	Dairy Husbandry
W. Lenton	Veterinarian
W. M. Bruce	Chemist
Martin Nelson	Agronomist
J. Lee Hewitt	Assistant Horticulturist
W. S. Jacobs	Assistant Agronomist
C. H. Tourgee	Assistant Dairyman
A. K. Short	Assistant Animal Husbandry
J. F. Stanford	Assistant Bacteriologist
H. D. Young	Assistant Chemist
Edith Gillam Black	Executive Clerk

Correspondents should notify the Director of any change of Post Office Address, error in Address, or failure or delay in receiving Bulletins.

C. F. ADAMS, Acting Director,
Fayetteville, Ark.

ARKANSAS AGRICULTURAL EXPERIMENT STATION.

FAYETTEVILLE, ARK., February 1, 1909.

To His Excellency, GEORGE W. DONAGHEY,
Governor of Arkansas:

DEAR SIR:—

In accord with the Federal Hatch Act of 1887, I herewith submit the Twenty-first Annual Report of the Agricultural Experiment Stations of the University of Arkansas. for the year ending June 30, 1908.

Respectfully yours,

C. F. ADAMS,
Acting Director.

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TWENTY-FIRST ANNUAL REPORT

OF THE

Agricultural Experiment Station of the University of Arkansas.

REPORT OF THE DIRECTOR.

The Experiment Station has now reached that stage of development where a sharper differentiation must be made relative to research, teaching, and demonstration work. As in many similar institutions this one has been drawn on largely to do teaching and to carry on various lines of extension work without proper State and Federal support. The Hatch Act expressly places the Experiment Station under the direction of the Agricultural Colleges, but does not impose upon it the duty of teaching. The Federal Act furthermore places the Federal funds under the general supervision of the Secretary of Agriculture. The latter's representative in the work is the Director of the Office of Experiment Stations. The Director of the Office of Experiment Stations publishes monthly the Experiment Station Record. In an editorial in a recent number of the Record, we find the following:

"The report of the standing committee of the association (Association of Agricultural Colleges and Experiment Stations, November, 1908), on station organization and policy, dealt with several of the matters discussed in the commission's (same association) report, but in a somewhat more specific way. Like those of previous years, it was to a large extent based upon the concensus of opinion of station men as to the most practicable means of securing the highest efficiency in station work.

The report points out certain defects of administrative organization which still prevail to some extent, and defines the functions of administration as related to research, as follows:

'(a) To help to determine in advance whether the proposed research is profitable and altogether advisable from the standpoint of the public, whose representative for the time being the administrative officer must be.

'(b) To assist in determining what lines of experimentation are calculated to throw profitable light upon the problem.

'(c) To help determine whether the work is best carried on by one individual representing a single line of inquiry or by two or more working in conjunction, and if the latter, to secure in advance a complete understanding as to mutual duties, rights, and responsibilities. Upon all these points the judgment and the point of view of the administrative offices is not only likely to be broader but certain to be freer from personal bias than is that of the professional investigator.

'(d) The experiment once decided upon, however, and funds provided, administration is over until results are due, when it begins again and does not cease until reports are published and circulated. The less administration during the progress of the work the better for all interests, and if the need of it becomes clear, it is the best of evidence that administration was remiss at the outset. Your committee cannot too strongly point out the necessity of the entire freedom as to methods of investigation on the part of the staff worker who has been employed because of his expert knowledge of the matter and methods of work in a highly specialized field.'

The ideal thus presented by the committee is 'administrative efficiency and sympathetic helpfulness without interference,' requiring 'for administrative officers men not only of good business methods and large outlook, but also with the highest obtainable training along some important line of science as related to agriculture.'

The committee favors an organization 'strong enough to recognize the interests of the whole station as above those of any department or separate interest and strong enough to enable the entire influence of the whole body to be exerted in any desired direction on short notice.'

As regards lack of permanency and continuity of work and resulting decreased efficiency, the committee enumerates a number of causes, but is of the opinion 'that the interference of teaching and extension work, and the paying of poor salaries, are among the prominent causes of unsatisfactory work and of frequent change.'

The committee 'reaffirms the recommendation of last year to the effect that there should be concentration on a few lines of research, and further recommends that there be close adherence to thoroughly considered, definite, and well-planned projects; that every effort be made to retain experienced and well-trained men; that an associate be appointed in each important department who shall be capable at any time of taking up the work of the chief; that the finances of the stations be so administered as to insure the supply of all suitable facilities for work; and that the integrity of long-established experimental fields should be maintained.'

In its inquiries regarding its relation of inspection work to other forms of station activity, the committee finds that 'the concensus of opinion leans toward an ideal station established for the purpose of research work, where little or no inspection work should impose a burden on the station; but that special conditions arise in many of the States making it of advantage to both the station and the State for the former to undertake such work.'

The committee recommends that 'where it seems best that the station should undertake to do inspection work (1) special funds should be provided to cover fully all expenses of such work; (2) where any considerable amount of inspection work is to be done, a separate division or department of the station be organized for carrying on the work; (3) with the exception of the administrative officers, the work be done by an independent force, paid wholly from the special funds appropriated for inspection; (4) special laboratories for carrying out the analytical work in connection with inspection be provided.'

With regard to the relation of station men to instruction, the committee finds that 'the opinion is almost unanimous that research work conduces to effective teaching, so long as it does not become so engrossing as to cause the teacher to neglect his classes.'

The committee therefore recommends 'as an ideal policy, to be adopted as rapidly as the conditions of the various stations will permit, that those charged with research be completely freed from all responsibility for routine class-room teaching; and that as a step in this direction the teaching required of the investigator be limited to a maximum of three hours a week during one semester annually, to be given along the line of his specialty.'

The recommendation of the committee will thus be seen to emphasize particularly the necessity, from the standpoint of scientific research in agriculture, for the sharp differentiation of such research work from educational propaganda and police duties and give full recognition to the fact that to secure a high order of this research work, the station organization and policy must be such that the investigator for at least the greater part of his time is free to devote undivided thought and effort to the work of investigation.

Practically, the greatest difficulty in attaining the ideals set forth in these reports grows out of the fact that in many cases our stations are organized under State laws are composite institutions. They are required to carry on control work, demonstrations, farmers' institutes, and the general diffusion of agricultural information. There will, therefore, be need of more or less reorganization of the stations, as more exclusive research institutions. The opportunity for this is now afforded by the growing recognition of extension work as a legitimate function of the agricultural colleges. As soon as the extension department of the colleges are efficiently organized and provided with adequate funds, it should be comparatively easy to transfer to them a considerable share of the business now performed by the stations.

As far as the Federal funds given to the stations are concerned, it will be the effort of this Department to confine work under the Hatch Act more strictly than ever to experimental work of a substantial kind, and no longer to permit expenditures from that fund for farmers' institute work, extension teaching, or the preparation of compilations. The Adams fund will, of course, be restricted to 'original research.' "

From the above it is to be seen that the Experiment Station is dependent upon State appropriations for all lines of extension work, such as farmers' institutes, demonstration, and inspection. The State's appropriation will be the measure of Arkansas' interest in her Experiment Station.

During the past year bulletins and reports have appeared as follows:

No. 96. Anthrax in Arkansas—R. R. Dinwiddie.
97. Anthrax and Anthrax vaccines (Technical)—R. R. Dinwiddie.
98. Rice—R. J. Nelson.
100. Meteorological Summary for 1891-1907—J. H. Norton.
101. Notes on Cattle Tick and Tick Fever. Tick eradication in Arkansas in 1907—R. R. Dinwiddie and W. Lenton.
20th Annual Report—W. G. Vincenheller.

The following is a summary of the work now being carried on by the Station, gathered from the data furnished by the heads of the respective departmeats:

DEPARTMENT OF PATHOLOGY AND BACTERIOLOGY.

1. (a) Investigation of the value of serum from hyperimmunized cattle in the control of Tick Fever by natural infection and by inoculation. Not yet completed.

(b) Tests of vaccination against hog diseases, and investigations bearing on contagious diseases of hogs.

(c) Continuation of work on hog feeding by extracts from cotton seed meal.

(d) Investigation of the pathological effects of excessive feeding of cotton seed to steers.

(e) Compilation of results of a feeding test of past winter on the comparative physiological digestive capacity of hogs of the lard and bacon type for nitrogenous and carbonaceous rations.

2. Results have been obtained showing the proper dosage of vaccine for hogs of different age and weight.

The pathological lesions of cotton seed poisoning of cattle more fully learned.

3. Investigations as described and carried on under the Adams Act.

4. An investigation of the relative value of hog feeding by alternate wide and narrow rations (at short intervals) as compared with uniform rations of same ultimate composition.

5. Work in hog vaccination is carried on in co-operation with the Department of Agriculture. (*DINWIDDIE*)

VETERINARY DEPARTMENT.

1. Principal investigations carried on during the year:

(a) Outbreaks of glanders in various parts of the State.

(b) Tuberculosis in herd of State Hospital for Nervous Diseases.

(c) Tick eradication in Northern Arkansas.

2. Practical results:

(a) The elimination of disease centers and the prevention of further spread of the disease.

(b) The establishment of a pasteurizing plant in the Hospital dairy.

(c) The work is still in operation.

Work in co-operation with the farmers of the State, and with the Department of Agriculture.

Tick eradication and the supervising of movements of cattle in the Northern tiers of counties, thus cleaning up hitherto infested areas and preventing the reinfectation of free areas.

Extension Work. Farmers' institute meetings have been held at different points, with a view to education along the line of tick eradication. (*LENTON*)

DEPARTMENT OF ENTOMOLOGY.

Principal investigations are studies in the life history of the Texas Tick, and the distribution of the San Jose Scale.

Studies of the life history of the Tick are carried on partially as co-operative work with the Bureau of Entomology at Washington, and partially under the Adams Fund.

Determining the periods of oviposition, incubation and non-parasitic stages is co-operative work, and the embryology of the Tick in reference to the life history of the fever germ is Adams Fund work.

In Bulletin 102, now in the hands of the printers, is given the distribution of the San Jose Scale in this State so far as known at present. In working out the distribution of this Scale several other scale insects have been brought to light. Some are of considerable importance and will receive attention. The San Jose Scale is a serious proposition, and there is great need of co-operation with fruit growers and farmers throughout the State.

Several species of plant lice are being studied in their relation to plant diseases.

An effort to record all the economic insects which occur in the State is continued as through the previous year. It is of considerable importance, as this State is not very well known from the standpoint of economic entomology.

Nursery inspection is carried on as usual. The San Jose Scale is beginning to interfere with the nursery business in Arkansas, as certificates have been refused on its account. (*ADAMS*)

AGRONOMY DEPARTMENT.

Work commenced during fall of 1907 and spring of 1908, results not definite as yet, neither all of season's data available. The work commenced includes:

Variety tests of cereals, cotton, grasses, etc., with a view to ascertaining most suitable varieties for the different sections of the State.

Fertilizer tests; soil tests on the Station farms and on sub-station farms, using different fertilizing elements and combinations of these in order to ascertain the elements most lacking for plant growth.

Breeding work by careful selection with wheat, oats, barley, rice and cotton, and the breeding of corn by using the ear to row selection method.

A test of tile drains at different depths and distances apart in order to compare the relative efficiency.

Rotation plots with two, three, four and five-year rotations in progress. Incomplete.

Test of different methods of cultivation of corn and cotton; a comparison of plowing four, six and eight inches deep; plowing six inches deep and subsoiling eight inches deep. Results not complete.

Soil test, using pot method in greenhouse of four soils from representative parts of the State. Experiments incomplete and will be continued another year.

Extension work. Farmers' institute meetings held in different sections of the State with a view of education along the lines of treatment of soils and conservation of soil fertility, etc. (*NORGORD*)

DEPARTMENT OF CHEMISTRY.

The routine work consists of making analyses for other members of the staff and analyzing samples from various citizens of the State. Seventy-six such samples were analyzed during the year, while a number of unimportant ones were analyzed and not recorded.

Completed Work. Bulletin No. 100, meteorological summary from 1891 to 1907, inclusive, written and published.

Incomplete Work in Progress. The digestibility of forage crops of the State. Some nutrition investigations. Origin of the so-called "Prairie Dog" mounds in co-operation with the Department of Geology. An experiment to determine the quantity and composition of the yearly growth from planting to the final limit of usefulness of two varieties of peaches, five of apples, two of grapes, one of blackberries, and two of raspberries is in co-operation with the Department of Horticulture.

Study of twig blight, also in co-operation with Department of Horticulture.

In co-operation with the Department of Pathology an experiment is in progress to determine the cause of the toxic effect of cotton seed meal and a commercial means of eliminating this injurious effect.
(*NORTON*)

DAIRY DEPARTMENT.

The experimental work with the dairy herd consisted of ration tests, as follows:

(a) Corn silage and cowpea hay.
Corn silage and alfalfa hay.
Corn silage and clover hay.

(b) Corn silage and cowpea, alfalfa and clover hay
vs.
Corn silage and prairie hay, using concentrate combinations made up from cotton seed meal, cornmeal and bran.

Experimental work in butter making consisted of:

(a) Control of the moisture content.

(b) Cream ripened vs. butter ripened butter.

Investigations recently inaugurated:

Ration tests, cows in low milk flow.
Corn silage, clover and cane hay.
Corn silage, alfalfa and cane hay.
Corn silage, cane hay and cotton seed meal.

Dairy extension work, in co-operation with patrons:

Herd improvement by selection and breeding.

(a) Keeping herd records for patrons.

(b) Herd improvement by the use of pure bred sire.

The records will be kept by the station until the progeny of the pure bred sire has been in milk two years. (*HOOPER*)

DEPARTMENT OF HORTICULTURE.

Run down condition of orchard lands shown commonly to be due to long cultivation previously in corn and other farm crops without rotation. Lands respond readily by applications of commercial fertilizers when humus has been supplied by suitable green manures and otherwise.

In the Ben Davis apple, the quality, firmness, juiciness, weight and flavor were greatly improved by increased nutrition.

Result: General interest in the better care of orchards, spraying becoming general where formerly no spraying was done.

Potatoes, tomatoes, onions and cabbage have received attention. Average yields with potatoes have been 300 bushels per acre against an average yield of 68 bushels per acre for the State on naturally better soils.

Further experimental tests of carbon bisulphid and other chemicals for destroying sassafras sprouts in fields.

Co-operative Work. Reducing damage to crops in land badly infested with nematodes; sodding bearing orchard in clover. (These with farmers.) Growing Hungarian varieties of apples in co-operation with the U. S. Department of Agriculture. Records of bearing and characteristics of varieties are being kept. Other miscellaneous plants are also on trial.

Adams Work. Lines named in previous reports are being carried on and promise valuable results. Considerable additions have been made to laboratory equipment in the way of apparatus and books needed in the lines of investigation.

The work upon apple twig and blossom blight and pear fire blight by the assistant horticulturalist has been largely in determining the bearings of the question under consideration. There is much encouragement in the possibility of a successful outcome of the investigation. While no data is ready for publication, the results of past work point toward the possibility of at least a practically useful control of the blight on the apple.

There has been some addition to the laboratory facilities and larger facilities contemplated for the future and a student to be employed part of his time as laboratory assistant.

Extension Work. From time to time the department is represented on the program at farmers' or horticultural meetings, and by articles in the press. Personal contact has proven of great value in increasing the interest of the farmer in improved methods, and the work of the Experiment Station. He is a better listener than reader, and more easily reached by example than by precept. (WALKER)

Changes in Staff. Dr. W. M. Bruce elected head chemist to fill vacancy caused by resignation of J. H. Norton, resigned.

Prof. Martin Nelson elected Agronomist to fill vacancy caused by the resignation of Prof. C. P. Norgord, resigned.

H. D. Young elected Assistant Chemist under the Adams Fund.

Rufus J. Nelson, Field Agent, appointed Professor of Agriculture in the College, to fill vacancy caused by resignation of G. A. Cole.

J. F. Standford appointed Assistant in Department of Pathology and Bacteriology.

Equipment. All departments have received additional and necessary equipment.

FINANCIAL STATEMENT.

AGRICULTURAL EXPERIMENT STATION

In Account with the United States Appropriation, 1907-'08.

Dr.	Hatch Fund.	Adams Fund.
To Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1908, under Acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams' Fund)	$15,000.00	$9,000.00
Cr.		
By Salaries	8,738.39	6,158.34
Labor	846.38	139.05
Publications	1,008.68	....
Postage and Stationery	273.41	44.21
Freight and Express	488.92	74.94
Heat, Light, Water and Power	253.34	....
Chemical Supplies	262.92	337.24

Seeds, Plants and Sundry Supplies........	$571.37	$108.37
Fertilizers	249.03	....
Feeding Stuffs	239.12	1,279.86
Library	142.55	123.90
Tools, Implements and Machinery.........	184.53	4.61
Furniture and Fixtures	253.33	79.20
Scientific Apparatus	......	92.81
Live Stock	723.99	104.96
Traveling Expenses	70.22	21.73
Contingent Expenses	181.00	....
Buildings and Land	512.82	430.78
Balance	......	....
Total..........................	$15,000.00	$9,000.00

To Receipts from other sources than the United States:

To State Appropriation (for the two years ending June 30, 1909)................	$35,200.00	
By overdraft Dairy Dept, 1905-'07.......	47.08	
To State Appropriation on hand July 1, 1907, for two years ending June 30, 1909......		$35,152.92

EXPENDITURES.

(For the Year Ended June 30, 1908.)

By Salaries	$ 6,108.37
Agricultural Maintenance	2,932.59
Horticultural Maintenance	2,494.37
Dairy Equipment	1,377.64
Institute Work	864.40
Tick Eradication	1,487.54
Sub-Stations	7,253.00
Traveling Veterinary	646.54
Total	$23,164.45
To Balance	11,988.47

To Farm Products (for the year ended June 30, 1908)....$ 2,396.06

EXPENDITURES.

By Seeds, Plants and Sundry Supplies	$ 363.40
Feeding Stuffs	193.45
Library	82.60
Tools, Implements and Machinery	229.58
Live Stock	243.00
Traveling Expenses	317.40
Contingent Expenses	200.00
Buildings and Rent of Land	214.87
Total	$ 1,844.30
To Balance	551.76

To Dairy Sales (for the year ended June 30, 1908)........$8,337.11

EXPENDITURES.

By Labor	$ 687.10
Publications	54.75
Postage and Stationery	170.80
Freight and Express	105.71
Patrons, for Milk and Cream	4,546.61
Feeding Stuffs	1,168.18
Live Stock	290.00
Contingent Expense	653.29
Buildings, Repair, Rent Land	430.21
Total	$ 8,106.65
To Balance	230.46

Total Balance July 1, 1908, including State Appropriations, Sales Farm Products and Dairy Sales........$12,770.69

The foregoing statements are copied from the Experiment Station books, which have been examined and approved by the Auditing Committee of the Board of Trustees and the Secretary of Agriculture, and is a correct statement of the expenditures from the Hatch, Adams, State, and miscellaneous funds for the year ended June 30. 1908.

Respectfully yours,

C. F. ADAMS,
Acting Director.

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